Draft Release of Stranded Marine Mammals to the Wild: Background, Preparation, and Release Criteria

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INTRODUCTION

The Marine Mammal Protection Act (MMPA) contains provisions recognizing that the welfare of individual marine mammals sometimes necessitates their removal from the wild [Section 109(h)]. The act as amended in 1988 [109 (h)(3)] emphasized that steps should be taken when feasible to return such animals to their natural habitat. These minor revisions [109 (h) (2) and 109 (h) (3)] have remained intact since 1988 (for the text of Section 109(h), see Appendix A).

Congress designated the responsibility of implementing the MMPA to the Secretaries of Commerce (for marine mammals of the order Cetacea, and members, other than walruses, of the order Pinnipedia) and Interior (for marine mammals of the Order Sirenia, walruses, sea and marine otters and polar bears). MMPA implementation has been designated by the Secretary of Commerce to the National Marine Fisheries Service (NMFS). Within the Department of the Interior, the Fish and Wildlife Service (FWS) is responsible for management and recovery activities while the U.S. Geologic Survey's Biological Resources Division is responsible for conducting research activities.

NMFS Policies

Until the early 1990s, it was NMFS practice to rely totally on the attending veterinarian for a determination as to whether a stranded marine mammal was releasable. Decisions were not always consistent, and even though the numbers were small, decisions as to the releasability of cetaceans carried a degree of controversy[1]. Therefore, a number of steps were taken toward establishing objective standards. In 1991, NMFS set up a series of basic medical and behavioral criteria to evaluate a rehabilitated marine mammal's release potential. At about the same time, it was determined that NMFS would individually review all release determinations involving rehabilitated cetaceans and, if necessary, would consult outside experts in making release determinations[2].

Recognizing that there was a need to examine the issues involved in release

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[1]For example, on the East Coast of the U.S. from 1993-1997, 465 pinnipeds and 61 cetaceans were released after having stranded.

[2]There are several different circumstances under which release of marine mammals may take place. This document addresses issues related to release of *stranded* marine mammals. Releasing stranded marine mammals involves wild animals that have been found in a distressed situation that reqire human intervention to ensure their survival. Other circumstances of release include: conservation releases (intended to strengthen a depleted population or to re-establish an extinct population), captive releases (releasing animals that have been in captivity), and experimental releases (focused on gathering data on the effects of a release on the animals being released, the population into which they are introduced, and/or the environment they are released in). The issues surrounding each type of release are unique. These guidelines are intended to address issues related to release of stranded animals.

determinations, the Marine Mammal Commission and NMFS sponsored a workshop in 1991 to analyze those issues (St. Aubin et al. 1996). The results of the workshop served as a starting point for setting up objective criteria to be used in release determinations.

A stronger impetus to formalize these release criteria came in 1992 when, as part of the Marine Mammal Health and Stranding Response Act, the Congress mandated that objective guidelines be established for determining releasability of rehabilitated animals. The Act was incorporated as Title IV of the MMPA and provides:

> The Secretary [of Commerce] shall, in consultation with the Secretary of the Interior, the Marine Mammal Commission, and individuals with knowledge and experience in marine science, marine mammal science, marine mammal veterinary and husbandry practices, and marine conservation, including stranding network participants, develop objective criteria, after an opportunity for public review and comment, to provide guidance for determining at what point a rehabilitated marine mammal is releasable to the wild.

The guidelines contained in this report are in response to that statutory mandate.

In 1996, NMFS published final regulations in the Federal Register that deal with the release of rehabilitated marine mammals (61 FR 21926, 10 May 1996). Appearing at 50 CFR 216.27, these regulations, applicable only to NMFS species, establish that **no animal will be authorized for release until it is determined that the animal poses no threat to wild populations if released and that the animal is healthy and likely to survive in the wild.** Such determinations must be made within six months of capture or import[3]. Appendix A contains the full text of 50 CFR 216.27.

If the determination is made that a stranded marine mammal should not be released, the preferred option is to place the animal in permanent captivity. It has been NMFS' policy since 1977 that stranded pinnipeds, other than walruses, will be used to fulfill captive display needs in lieu of authorizing a take from wild populations. Therefore if a stranded marine mammal, for which NMFS has management responsibility, is determined to be unreleasable, when possible, such animals should be placed in permanent captivity.

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[3]Release determinations may be postponed with permission of the NMFS Regional Director or the Office Director, but must be reevaluated at intervals of no less than six months until two years from capture, at which time a final decision must be made.

The regulations in 50 CFR 216.27(b) state that the person with authorized custody of an animal that has been determined to be unreleasable must request authorization to retain or transfer custody of the animal. The NMFS Office Director may authorize custody of the animal for scientific research, enhancement, or public display purposes. In order to permanently hold a rehabilitated animal, the rehabilitation facility must apply by letter to the Office of Protected Species, Permit division to transfer or permanently hold the animal. Included with this request should be a letter of concurrence of non-releasability by the Regional Administrator from the region in which the rehabilitation facility resides. For public display, the facility which will be permanently maintaining the animal must comply with the public display requirements of 16 U.S.C. 1374 (c) (2) (A).

FWS Policies

The FWS is similarly obligated to develop objective criteria to determine the releasability of trust species (e.g., Pacific walruses, sea otters and West Indian manatees). The FWS has been actively involved in rescue and rehabilitation programs for these animals. The ultimate goals for these programs are to rehabilitate and release sick and injured animals, to the extent that such releases are practicable. For Endangered Species Act (ESA) listed southern sea otters in California and West Indian manatees in the southeastern United States, this effort has a role in recovery efforts for these species. The rescue and rehabilitation program enhances research, public outreach and environmental education.

Given the uniqueness of the FWS species involved, species-specific programs and guidance have been developed to assess when to remove animals from the wild, the types of treatment that may be needed, what factors should be considered when evaluating an animal for release, and how best to release these individuals.

The FWS' West Indian manatee rescue and rehabilitation program is conducted according to the provisions of an MMPA enhancement permit issued by the FWS' Office of Management Authority (OMA) to the FWS' Jacksonville, Florida, Field Office. The permit authorizes take activities for an unspecified number of manatees for the purpose of enhancing its survival and recovery consistent with the FWS' recovery plan developed pursuant to the ESA. The program established under provisions of the permit coordinates a network of individuals, facilities and agencies through Letters of Authorization to rescue, rehabilitate and release manatees in need of rehabilitative care. Release criteria have been developed to facilitate the evaluation of release candidates.

For other FWS marine mammal species except polar bears, rescue, rehabilitation and release decisions are made on a case-by-case basis by FWS species coordinators and the FWS' OMA (see Appendix C). The age class of polar bears normally found stranded in Alaska and

subsequently recovered are not presently considered candidates for rehabilitation and release back into the wild. Such animals are normally considered on a case-by-case basis for permanent placement in public display facilities.

In summary, by publishing regulations and drafting release criteria, NMFS and FWS have taken steps to provide guidance for the release of stranded marine mammals. This document builds upon these earlier efforts and formalizes the process by which release determinations should be made. It describes what should be considered, who should be involved in the decision-making, and how the process should evolve. The recommendations are based on consultations with experts in the fields of marine mammal behavior, medicine, and biology.

1. GENERAL GUIDELINES & DOCUMENT STRUCTURE

1.1. Document Structure

These guidelines are divided into four sections: pinnipeds (seals, sea lions, and walruses), cetaceans (whales and dolphins), sea otters, and sirenians (manatees). These are discussed separately, so that the unique aspects of each can be addressed. Within each section, four areas of consideration are presented: natural history, medicine, behavior, and release. The areas of consideration identify specific criteria that should be addressed when considering an animal's release candidacy. Some of the criteria, if not met, dictate that an animal should not be released. However, many of the release criteria do not easily translate into yes-no release determinations. These issues must be evaluated together, on a case-by-case basis, to determine if the animal's release satisfies the agencies' two fundamental criteria: **the animal poses no threat to wild populations if released, and the animal is physically and behaviorally healthy and likely to survive.**

Within each area of consideration, there are discussions of required treatment actions, strongly recommended actions, and suggested actions, which are based on current rules and regulations or on medical considerations. Data gaps, suggested research, and potential new evaluation techniques are also discussed. Appendix B provides references which provide further information on rehabilitation and release of marine mammals.

1.2. Release Process

1.2.1 NMFS

According to current regulations, release decisions must be made within six months of capture or import. Release determinations will be made by the stranding designees on-site, in coordination with the Regional Stranding Coordinator and the staff or consulting veterinarian (Appendix C provides Stranding Coordinator contact information). This document outlines what should be considered and offers some benchmarks that should be met before release. Appendix D lists the information that should be submitted to NMFS before release will be approved (unless the region chooses to waive this requirement). Other information useful for on-site medical and behavioral evaluations is provided in Appendix E. The Regional Offices of the NMFS, when reviewing release candidacy or when considering renewals of Letters of Agreement (LOA), will refer to these documents for guidance.

1.2.2 FWS

For the FWS, West Indian manatee release decisions are also made within six months of captures. However, manatees held for periods exceeding six months are, in many cases,

considered releasable. Short-term cases being considered for release are evaluated by facility veterinarians and the FWS Manatee Recovery Coordinator. An interagency oceanaria group, in conjunction with the Manatee Recovery Coordinator, evaluates long-term cases for release as part of recovery planning efforts. This evaluation is carried out on a biannual basis. Final release determinations are made by FWS.

For other FWS marine mammal species, such decisions are made on a case-by-case basis by FWS species coordinators and the FWS' OMA, all of which are listed in Appendix C.

1.3. Release Requirements

1.3.1. NMFS

50 CFR 216.27(a)(2) through (5) describe the NMFS requirements for releasing rehabilitated cetaceans and pinnipeds (except walruses). These subparts establish that notification must be provided to the NMFS Regional Director describing the animal and the release date, location, and method. All animals must be released in the home range of the wild populations or stock, if it is known. According to 50 CFR 216.27(a)(5), all marine mammals must be tagged or marked prior to release. See specific species sections for guidance on tagging methods (3.5.1, and 4.5.1).

1.3.2 FWS

For the FWS, West Indian manatees are generally released into the geographic area from which they were captured. Release sites for captive born animals are based on parental history and site suitability. All manatees are tagged or marked prior to release to aid in future identification (6.5.1).

For other FWS marine mammal species, such decisions are made on a case-by-case basis by FWS species coordinators and the FWS' OMA, all of which are listed in Appendix C.

1.4. Emergency Response

There will be certain emergency situations in which the standard operating procedures or criteria relative to release may be altered. Such situations include: (1) hazardous material spills, (2) oil spills, or (3) unusual mortality investigations[4].

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[4]The Marine Mammal Health and Stranding Response Act characterizes an *unusual mortality event* as having the following characteristics: (1) it is unexpected; (2) it involves a significant die-off of any marine mammal population; and (3) it demands an immediate response. In addition to the obvious circumstances involving significant numbers of marine mammal deaths within a short period of time, two other instances require response: (1) when there is a mass stranding of unusual species of cetaceans and (2) when even small numbers of a severely endangered marine mammal species appear to be affected (Wilkinson 1996).

In hazardous material or oil spill situations, specific medical criteria may be added to those included in this document. In addition, determinations of time of release will be dependent on the type and duration of exposure as well as timing of clean-up efforts. Evaluation of release site and timing must be done in consultation with the appropriate authority for the incident assessment, clean up, and restoration.

In unusual mortality investigations, the decision for release will reside with the on-site coordinator in consultation with experts, including the Working Group on Unusual Marine Mammal Mortality Events[5]. Release of any animals into the area of the event may be denied until the cause of the event has been determined and no further threat is predicted or until the event is over.

In summary, release of rehabilitated animals in emergency response situations will be determined on an event-by-event basis in consultation with appropriate authorities and experts.

1.5. Crossing State Lines

1.5.1. Triage - Medical Emergency--NMFS

Animals may be transported across state lines to receive medical treatment or for adequate rehabilitation services. The Regional Stranding Coordinator should be notified as soon as possible but within 24 hours of transport. As a courtesy, the state veterinarian[6] may also be notified of the transfer.

1.5.2. Medical Treatment--NMFS

Animals may be transported across state lines from one rehabilitation facility to another facility for medical treatment. The Regional Stranding Coordinator must be notified prior to transport. As a courtesy, the state veterinarian may also be notified of the transfer.

1.5.3. Release--NMFS

If an animal is to be transported across state lines for release, the proposed transport must have (1) regional approval, (2) health certification by an authorized marine mammal veterinarian,

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[5]The Working Group on Marine Mammal Unusual Mortality Events was created in 1992, when Congress passed the Marine Mammal Health and Stranding Response Act. Title 4, Section 404 of this Act created a multi disciplinary working group to provide guidance to the Secretaries of the Interior and Commerce in determining when a mortality event is occurring, in developing a response plan to such an event, and in developing a contingency plan for responding to such an event. The Group can be contacted through the National Marine Mammal Stranding Coordinator (listed in Appendix C).

[6] The State veterinarian is a Veterinary Medical Officer for the U.S. Department of Agriculture

and (3) an approved release site (see Sections 3.5.3., 4.5.3., and 5.5.3). The state veterinarian should also be notified prior to transport if the animal will reside in the state prior to release.

1.5.4 Transport--FWS

Transport of manatees for any reason should occur only with the approval of the FWS Manatee Coordinator. For all other FWS species, approval must be obtained from the FWS' Office of Management Authority (OMA; see Appendix C) in consultation with the appropriate FWS Regional Office. In the event of an emergency, the OMA must be notified within 24 hours of the transport.

1.6. Crossing NMFS Regional Lines

1.6.1 NMFS

The National Marine Fisheries Service has established five regions: (1) Northeast (Maine, New Hampshire, Rhode Island, New York, Massachusetts, Connecticut, Maryland, Delaware, and Virginia), (2) Southeast (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, and the Caribbean), (3) Southwest (California, Hawaii, and the Pacific territories), (4) Northwest (Oregon and Washington), and (5) Alaska. Each region has a Stranding Coordinator, a network of stranding response members (many of whom are volunteers), and rehabilitation facilities for handling stranded animals.

In the past, requests have been made to move animals between regions for rehabilitation. NMFS has determined that animals should not be moved between regions. Facilities should be reserved for strandings which occur within the region or state. Facilities capable of holding and rehabilitating animals are limited, therefore space must be reserved for animals stranding in the region. Exceptions may be made by the Regional Stranding Coordinators in cases where there are compelling circumstances.

Release sites, however, should be independent of state or regional boundaries. Location for release should be dictated by the biology of the animal, as described in sections 3.5.3. and 4.5.3.

1.6.2 FWS

When moving any FWS species for the purposes covered in this section, the information presented for the FWS in section 1.5.4 applies.

1.7 Updating the Guidelines

The NMFS and FWS will revisit these guidelines as new information becomes available

regarding medical or behavioral assessments, rehabilitation, or release. Additional tests may be recommended should a new disease become a risk. The agencies will distribute this information to the Regional Coordinators who will notify stranding network participants.

In addition, the NMFS is formulating a plan to fill data gaps surrounding the outcome of rehabilitation efforts. The plan will outline how the agency can obtain information for evaluating release success and identifying the criteria important for release success.

1.8. Funding

The NMFS provides limited funding to the regions to be used in support of the Marine Mammal Health and Stranding Response Program, however the responsibility for funding rehabilitation efforts generally falls on the rehabilitation facility. There may be occasions where rehabilitation facilities would be asked to contribute information (for example through participation in serum or tissue banking, monitoring projects, or unusual mortality event investigations). In these cases, the Services may provide financial support, but this will be determined on a case-by-case basis. The funding for most of the testing recommended in these guidelines will have to come from the rehabilitation facilities themselves.

2. ETHICS

In addition to the various objective behavioral and medical measurements that contribute to a release determination, there are certain ethical issues that may need to be considered. These issues include: how individual animal welfare compares to the welfare of wild populations; what should be done with animals deemed non-releasable; and when is euthanasia an appropriate action. Such questions are very difficult to resolve, but should be considered in some release determinations. The following provides guidance on how the NMFS and FWS will address such issues.

2.1. Benefits of Rehabilitation

There are many scientific benefits that result from rehabilitation of marine mammals that can be used in conservation and management. First, live stranded marine mammals can provide information on the causes of natural and unusual morbidity and mortality, pathogenesis and the course of diseases, healing processes, and basic biomedical processes. Some of this information could not be gained from a dead animal. Careful health assessments during rehabilitation may alert us to some environmental or disease problems prior to a massive population decrease. It is important to note that while these are possible benefits, it is not suggested that scientific investigations override individual animal welfare. Individual animals should not be treated solely for purposes of gaining insight into the nature of their illness or injury. Second, rehabilitation efforts can provide valuable information on treatment procedures, proper drug dosages, surgical procedures, disease pathogenesis and clinicopathologic parameters, as well as other biological or physiological information. Should a population decline markedly, this information may be used to determine the cause of decline and guide management decisions.

And finally, some marine mammal strandings are related to human activities (ingestion or entanglement in marine debris, boat strikes, entanglement in fishing gear, etc.). Rehabilitation efforts can remedy these human-related injuries. Some people believe marine mammals should be rehabilitated *only* when their injuries or illnesses are caused by human activities. Their argument is that we should not interfere in cases of natural mortality. Furthermore, some people believe that resources for rehabilitation (space, funding, and personnel) are limited and should be reserved for animals who would be healthy were it not for human interference. Given the pervasiveness of toxic chemicals of anthropogenic origin in the marine environment, the high concentrations of many of these chemicals in marine mammal tissues, and the demonstrated and suspected effects of these toxicants on marine mammal health , the distinctions between human and natural causes of strandings have become difficult to discern. Currently the marine mammal stranding network does not limit rehabilitation to animals whose injuries are caused by human activities. However this may be a step that must be taken in the future if conditions change in the

stranding network due to resource limitations or if basic changes occur in the ethics of rehabilitation.

2.2. Population versus Individual Animal Welfare Issues

As stated in the NMFS release regulations (50 CFR Chapter II, Part 216), a primary concern with release of rehabilitated marine mammals is that they do not adversely affect wild populations. Therefore, when evaluating the potential for release of a rehabilitated animal, both the welfare of the individual animal *and* the welfare of the wild population must be considered (Ballou and Lyles, 1993). While the rehabilitation of stranded marine mammals may be a humane and responsible gesture on behalf of individual animals, for most non-endangered species, rehabilitated animals do not make a significant contribution to the conservation of wild populations. This is because the number of animals that can be rehabilitated is relatively small compared to the size of non-endangered wild populations and probably insignificant when considered in population growth (St. Aubin et al., 1996).

In fact, the release of rehabilitated animals could have a negative impact on wild populations. Relative to this, two issues which have to be considered are: 1) introduction of diseases into wild populations and 2) genetic impacts on wild populations.

First, releasing animals into the wild creates the potential for disease transmission or introduction of new diseases (Gilmartin et al., 1993; Griffith et al. 1993; Spalding and Forrester, 1993). Regardless of whether a marine mammal strands due to illness, all stranded marine mammals are undergoing stresses which may make the animals more susceptible to disease and less likely to "fight off" infections. In addition, all animals placed in rehabilitation are in a foreign environment which may contain new pathogens not residing or encountered by the wild population. Therefore these animals could potentially function as carriers for current or new diseases if they are returned to the wild. This has become a more significant issue as new diseases with serious epizootic[7] potential have been detected and as infectious agents may become more pathogenic (Spalding and Forrester 1993). The potential role of rehabilitated animals in the emergence of new diseases into naive populations is of clear concern to wildlife population conservationists. Therefore careful evaluation of pathogens in rehabilitated animals is essential before release.

The second concern for wild populations relates to the genetic impacts of release. Some people believe that the least fit members of a population may be those that strand. The concern is that if these animals are released back into a wild population, the overall genetic health of that

[7]Epizootic - 1. Attacking many animals in any region at the same time; widely diffused and rapidly spreading. A disease of high mortality which is only occasionally present in an animal.

population could be affected and the natural selection process altered. While the overall health of the population is of serious concern, the genetics issue is not presently considered a major concern 1) because of the small numbers of animals released relative to population sizes and 2) because releasing an animal back into its natal population does not introduce new genes into the population. Unless there is some evidence that a particular condition has a genetic basis, the release determination should not be prohibited on the basis of genetics. Animals should only be released into their genetic population or stock. In the case of small, endangered populations, individuals may need to be released for the survival of the population despite the genetic implications.

When questions of disease or genetics arise regarding the welfare of individual animals and wild populations, the welfare of wild populations will override individual animal concerns. NMFS and FWS have responsibility for the welfare of individual marine mammals, but each agency's primary responsibility is to maintain healthy wild populations. *Therefore, when there is a documented reason to believe that re-introduction of an individual animal could compromise the welfare of a wild population, a determination to release would be irresponsible. In instances when there is serious potential for a conflict between welfare of an individual animal and wild populations, the issue shall be resolved in favor of the wild populations.*

2.3. Non-releasable Animals

The disposition of animals determined to be non-releasable raises a second type of ethical issue: what to do with non-releasable animals. The options for such animals are limited to (1) placement in permanent captivity or (2) euthanasia. Ethical concerns have been raised concerning both options.

2.3.1. Permanent Captivity

Some groups have argued that maintenance of marine mammals in captivity is inappropriate and unethical. Because of the statutory framework of the MMPA, however, it is not necessary for the Services to address this broader societal issue. The MMPA clearly recognizes public display of marine mammals as a legitimate activity [Title I, Sec. 101(a)(1)], and the Congress has examined issues involved in captivity on a number of occasions without changing this principle. Indeed, within this context, it has been NMFS' policy since 1977 that when possible, stranded marine mammals (cetaceans and pinnipeds other than walruses) be used to fulfill public display needs in lieu of authorizing a take from wild populations. This policy was codified in 1996: "Notwithstanding any of the provisions of this section, the Office Director may require use of a rehabilitated marine mammal for any activity authorized under subpart (D) in lieu of animals taken from the wild." [50 CFR Chapter II Part 216.27(b)(4); Appendix A contains the full text of part 216]. If a determination is made that a stranded marine mammal should not be released into the wild, the preferred option is that, when possible, such animals be

placed in permanent captivity[8].

The FWS follows a similar practice. The MMPA allows, with the exception of animals from depleted species, for the issuance of public display permits for stranded animals which have been deemed non-releasable [Section 104(c)(7)]. Prior to issuance of a public display permit for taking of a non-depleted species from the wild, the FWS routinely requires the applicant to demonstrate that alternative sources (i.e., stranded non-releasable animals) are not available. In the case of depleted species (which by MMPA definition includes ESA listed endangered or threatened species), the MMPA does not allow for the issuance of a public display permit. However, captive maintenance of such animals can be authorized under an enhancement permit for recovery of the species or stock and public display may occur incidental to that if it does not interfere with the recovery objectives.

2.3.2. Euthanasia

The issue of whether or under what circumstances stranded marine mammals should be humanely destroyed encompasses more than the question of the disposition of non-releasable animals. Many strandings are caused by irreversible, extensive, or disabling medical conditions. In cases of irreversible illness and/or injury, pain and suffering may be prolonged if euthanasia is not an alternative. Euthanasia is commonly accepted as humane in such circumstances and is specifically mentioned as such in the MMPA. Both NMFS and FWS support euthanasia in cases of irreversible illness or injury.

Euthanasia, in addition to being a humane way to deal with irreversible illness or injury, can be a responsible action from the point of view of conservation. In some circumstances, release of an individual may pose risks to wild populations, which are greater than the benefits of releasing an individual animal. Euthanasia may be considered in such cases.

In many stranding situations, consultation with the agencies in a timely manner to prevent further suffering is not really an option. Furthermore, without being on-site, agency personnel are unlikely to have the full range of information necessary to make such a determination. NMFS will rely on the professional judgment of trained veterinary personnel who are on-site to make such determinations in the best interest of the animal. For strandings involving FWS species, the appropriate FWS stranding coordinator or the FWS' Office of Management Authority must be contacted for a determination on the disposition of the animal(s).

When the decision is made that euthanasia is the appropriate course of action for an animal, certain information related to the case should be provided to the Services. Stranding

[8]It should be noted that the development and revision of release standards is done independently of captive display considerations. The NMFS does not and will not consider captive display needs when establishing or amending guidelines for release of stranded marine mammals.

reports should note that the animal was euthanized, and should identify the method used. Euthanasia without consultation is acceptable for medical reasons, however euthanasia for non-medical reasons will only be done in consultation with the NMFS or its designee for cetaceans and pinnipeds except walruses. Euthanasia of manatees, walruses, sea otters or polar bears for non-medical reasons will be determined by the appropriate FWS stranding coordinator or the FWS' Office of Management Authority.

2.4. Borderline Animals

Even with objective guidelines for making a release determination, there will be cases when the prospects for survival in the wild will be considered marginal, but an individual animal may have a chance of surviving. In such circumstances, the Services will consider allowing such an animal to be released if scientific experts so advise and if an adequate monitoring program can be instituted. If possible, release plans should include plans for recapture if the animal does not fare well. If handled carefully, releases of borderline animals may provide information which will allow better assessment of criteria for future release determinations. It could be of value in some cases to conduct experimental reintroduction of rehabilitated animals, as long as the experiment includes adequate monitoring and provides a high probability of recovering the animal if it does not thrive. Such efforts could help in refining the diagnostic and treatment protocols that can then be used when treating threatened or endangered species (Porter 1992).

3. RELEASE GUIDELINES FOR STRANDED PINNIPEDS

3.1. General Information

While it is recognized that the three pinniped families[9] differ in many aspects, this section applies to all pinnipeds unless otherwise noted. Consultations for release for phocids and otariids will be made with the NMFS' regional stranding coordinator and for odobenids (i.e., walruses) with the FWS' Alaska Region (Appendix C contains addresses and phone numbers for consultations).

As noted in Section 1, there are conditions listed below which should automatically preclude an animal's release. The rest of the guidelines should be considered together when determining if a particular pinniped should be released.

3.2. Natural History Considerations

3.2.1. Age

Most age classes are appropriate for release as long as they are deemed healthy. Pups should only be held for the natural duration of lactation. If all other criteria are met, once the pup reaches weaning weight or body condition, it may be released.

3.2.2. Morphometrics

The straight length (for growing animals), weight, and blubber thickness at standard sites should be taken for each animal upon entry and just prior to release. If practical, the axillary girth should be taken at admission and at release. Taking weekly weight measurements throughout the rehabilitation period is also recommended, if possible. These measurements will be useful in continued assessment of condition and health status during the rehabilitation period and will provide reference data for release success evaluation if deemed necessary.

3.2.3. Reproductive Status

Reproductive condition should not preclude release, unless a female is in late pregnancy or in estrus. Although it is preferred that pups are born in the wild, late term pregnant pinnipeds should not be released unless the veterinarian feels that the animal can safely handle the stress of transportation and introduction into the wild. An estrus female should be held until the estrus cycle is completed. If a mother is rescued with a pup, or gives birth while at the rehabilitation facility, the development of the pup should determine the timing of release.

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[9] The three families are: Phocidae (true seals), Otariidae (eared seals), and Odobenidae (walruses). Thirty-three different species of pinnipeds are found throughout the world today: eighteen phocids, fourteen otariids and one odobenid.

3.3. Medical Considerations

The ultimate goals of the medical evaluation are two fold: to determine that the animal will pose no threat to the wild population if released, and to determine that the animal is healthy and likely to survive in the wild. Medical evaluation to determine release candidacy is done by the experienced staff veterinarian. Medical history, physical examination and clinicopathologic data collection may optimize our ability to determine that an animal is healthy and will pose no threat to wild populations. However, this process does not guarantee this because our knowledge of the disease and disease pathogenesis in marine mammals is incomplete.

3.3.1. Medical History

Evaluation of release candidacy involves an in-depth look at the animal's medical history. A good medical history should include the following: site of stranding, health or condition at stranding, cause of stranding if known, disease history (current, clinical, and serologic), treatment received during rehabilitation, documentation of physical and behavioral developmental history, and exposure to disease. If an animal is held with or in close proximity to other animals undergoing rehabilitation, the disease history of pen mates/neighbors will have to be considered. Evaluation will be directed to ensure that the animal has not been exposed to and have contracted new disease while in rehabilitation. Ideally, information on disease and health history of the population would be available to compare with the medical history of this individual case. **The animal should be free of therapeutic drugs for a minimum of one week prior to release**.

3.3.2. Physical Examination

Although a complete physical examination is not always possible during triage, once in the rehabilitation facility the animal should receive as thorough a physical examination as is possible. A thorough physical exam should be performed on each animal upon entry, periodically during the rehabilitation period (i.e. monthly or weekly), and prior to release or at the time of notification of release.

3.3.3. Diagnostics

At a minimum, a CBC (complete blood count) and serum chemistry panel should be done on admission to guide diagnosis and treatment and prior to release to provide information on medical release candidacy. Table 1 lists pinniped CBC and serum chemistry reference intervals. Other diagnostic tests may be necessary, as indicated by the response and condition of the animal or as circumstances dictate. A minimum of 3 ml of serum from each sampling should be maintained frozen for possible retrospective studies involving future infectious disease epizootics. For NMFS species regional and national serum banks are being developed and the aliquots will be stored in regional banks. Serum banks are valuable when conducting disease investigations to determine if infectious agents are new or more prevalent in a population (Munson and Cook, 1993).

Table 1. Pinniped Hemotology, Serum Chemistry and Reference Intervals. From *CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation* (L.A. Dierauf, ed.) unless otherwise noted.

Blood Parameters	Units	Harbor Seal (*Phoca vitulina*)	California sea lion (*Zalophus californianus*)	Hooded seal (*Cystophora cristata*)	Harp seal (*Phoca groenlandica*)	Gray seal (*Halichoerus grypus*)	Walrus (*Odobenus rosmarus*)
Erythrocytes							
n=		26	92	252	235	6	6
RBC	$10^6/mm^3$	3.99-5.61	3.67-5.46	4.1	4.96-5.57	4.36-5.90	3.37-3.90
Hgb (Hb)	g/dl	14.4-24.0	12.0-19.5	24.2	21.2-26.2	14.4-21.9	15.0-18.5
PCV	%	40-66	35-55	58	55-63	46-66	45-51
MCV	fl	92-121	92-116	142	105-121	92-124	133-144
MCH	pg	33-44	32-42	60	40-51	31-42	44-47
MCHC	g/dl	34-38	32-43	42	39-45	28-37	35-39
Leukocytes							
n=		26	93	252	240	6	6
WBC	$10^3/mm^3$	7.6-19.4[10]	7.1-23.3[11]	9.6	7.8-16.7	6.5-16.6	6.0-13.0
PMNs	%	46-85	31-90	n.d.	n.d.	52-76	50-80
Bands	%	0-5	0-19[2]	n.d.[12]	n.d.	0	0
Lymphs	%	9-45	9-61	n.d.	n.d.	9-38	15-45
Monos	%	1-17	0-22[2]	n.d.	n.d.	0	1-6
Eos	%	0-9	0-8	n.d.	n.d.	0-10	6-20
Basos	%	0-2	0	n.d.	n.d.	0	0
Liver enzymes and bilirubin							
n=		15	92	145	60	6	6
SGOT/AST	IU/l	70-241	16-178	22-307	26-318	24-59	42-62
SGPT/ALT	IU/l	36-69 (n=12)	n.d.	0-63	14-226	11-30	15-40
Total bilirubin	mg/dl	0.1-0.5	0.0-2.1	n.d.	0.2-0.6	n.d.	0.1-0.3
Direct		n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Indirect		n.d.	n.d.	n.d.	0.1-0.2	n.d.	
GGT	IU/l	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

[10]Presumably relfect animals with subclinical inflammation.

[11]Presumably ill or stressed animals.

[12] n.d.=no data available

Blood Parameters	Units	Harbor Seal (*Phoca vitulina*)	California sea lion (*Zalophus californianus*)	Hooded seal (*Cystophora cristata*)	Harp seal (*Phoca groenlandica*)	Gray seal (*Halichoerus grypus*)	Walrus (*Odobenus rosmarus*)
Liver, muscle, and kidney enzymes							
n=		14	60	145	33	6	6
CK (CPK)	IU/l	n.d.	n.d.	n.d.	n.d.	n.d.	24-95
BUN	mg/dl	25-97	15-159	24-84	32-47	32-108	15-40
Creatinine	mg/dl	0.4-1.4	0.1-1.2	1.6	1.6 (n=1)	n.d.	0.1-0.3
AP	IU/l	30-303	47-760	n.d.	20-50	n.d.	60-142
LDH/GDH	UI/l	321-1250	91-2865	n.d.	117-236	n.d.	189-221
Glucose, lipids, and pancreatic enzymes							
n=		25	57	136	69	6	6
Glucose	mg/dl	41-164[4]	17-205[4]	59-1231	119-173 (n=9)	70-94	90-125
Triglycerides	mg/dl	22-362	6-277	n.d.	n.d.	n.d.	50-152
Cholesterol	mg/dl	212-302 (n=12)	n.d.	220-232	217-332	n.d.	300-440
Amylase	IU/l	n.d.	n.d.	n.d.	290	n.d.	n.d.
Lipase	IU/l	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Proteins							
n=		25	66	84	224	6	6
Total Protein	g/dl	6.1-9.7	3.7-10.0	8.0	6.3-8.1	6.8-9.3	6.2-7.5
Albumin	g/dl	3.1-4.0	3.1-4.4	3.8 (n=74)	n.d.	n.d.	n.d.
Globulin	g/dl	2.1-5.6	n.d.	n.d.	n.d.	n.d.	n.d.
Electrolytes							
Sodium (Na^+)	mEq/l	145-156	140-154	152	149-159	153-168	144-148
Potassium (K^+)	mEq/l	4.0-6.0	3.8-5.9	4.0	3.2-4.1	4.2-4.8	2.8-3.6
Chloride (Cl^-)	mEq/l	97-111	100-117	111	101-110	106-114	107-115
Phos	mg/dl	4.3-7.9 (n=12)	n.d.	7.2	4.3-5.8	n.d.	5.0-7.2
Calcium (Ca^{++})	mg/dl	8.8-10.9	8.2-10.6	9.6	9.3-9.7 (n=34)	9.9-12.4	8.9-10.0
CO_2	mEq/l	24-26	12-30	n.d.	n.d.	n.d.	n.d

[13] Low (minimum) glucose values suggest lab error or ill/stressed animals.

A. Parasitology

Evaluation of parasite loads is an integral part of the medical evaluation, since many pinnipeds have clinical illnesses associated with parasitism. If clinical disease is associated with parasitism, the animal should be treated. This evaluation should include fecal flotation, sedimentation, and a direct smear. Both fecal floatation and sedimentation are required to detect *Otostrongylus circumlitus*, which is prevalent in animals on both coasts. Other diagnostics may include Baerman analysis or gastric sampling as determined by the veterinarian. Treating for subclinical parasitism is discouraged, based on the knowledge of the harmful effects of such treatment in other species and the potential for allowing development of anthelmintic resistant parasites. Parasitism should be treated even if the animals are asymptomatic in *Mirounga* because of the high peracute mortality rate. A concentration heartworm test (Knott's procedure or Filter test) should be done to screen for microfilaria. If microfilaria are found they should be identified as to species using morphometrics and other standard means of identification prior to initiation of treatment unless clinical signs so dictate. A large proportion of Zalophus and Callorhinus may be positive for microfilaria due to the inconsequential fascial worm (K. Bechman, personal communication).

B. Urinalysis

Evaluation of urine is a useful tool for diagnosing animals. Some abnormalities seen in the urinalysis may be indicative of urinary tract disease while others may reflect other organ disease processes. Urinalysis should include the following parameters: physical characteristics, chemical characteristics, and sediment examination. These results should be considered in conjunction with blood work and other health indices. If feasible, urinalysis should be performed at admission and as part of the release candidacy evaluation.

C. Immunology

Evaluation of immunological competence prior to release may be important in some cases (see Appendix G for list of tests). Most evaluations to analyze immune function are still developmental or experimental and are not in common use for more than a few species. Until such time that these tests are developed, become validated and are in common use for a wider range of species, no specific test will be recommended for general use. Certain labs have developed certain tests for specific species, and these should be used as deemed necessary by the attending veterinarian.

D. Infectious diseases

In general the methodologies for detecting infectious organisms include serology, isolation, and Polymerase Chain Reaction (PCR). Polymerase Chain Reaction can be used to amplify segments of genetic material from minute quantities of organisms or non-growing microbes.

Serology. Serology is principally used to identify pathogens to which the animal has been exposed and is used extensively in retrospective or other epidemiological studies. Serology is rapid and usually easily conducted. In some cases a rising titer can indicate active infection or exposure in individual animals. In addition, serological examination upon admission can guide the care of the animal and examination at release can determine which, if any, pathogens the animal has been exposed to in the facility. Ideally, serological tests should be performed at least twice, once upon admittance and then a minimum of two weeks later and may be performed just prior to release as part of the candidacy assessment. However in some cases, testing should be delayed upon admittance. It is often difficult to obtain enough blood at admission from an

emaciated animal in shock to allow for more than a CBC, therefore sufficient blood may not be obtained until several days after initial admission. In addition, certain stranding situations result in high mortalities (e.g. starving pinnipeds in an El Nino). Delaying testing may eliminate expensive testing of animals that die early in rehabilitation. Evaluation of serology may also be delayed in cases where the cause of stranding is more obvious and non-infectious (or when survival is unlikely). Once the pre-release sample is drawn, the samples can be run together, reducing analytical variations.

Required serological tests for release may be based on a documented incidence of a pathogen(s) or disease(s) in a given geographic area, on the potential for epizootics or on the potential for known or suspected agents to have a significant impact on wild animals or human health.

Microbial culture and isolation (viral, bacterial [aerobic/anaerobic], fungal). Microbial isolation provides a definitive answer to the presence of a microbe; however, failure to isolate the organism in culture does not mean the microbe is not present. When indicated by the condition of the animal, microbial cultures and sensitivities may be done to better guide therapeutic actions. Cultures may be obtained from the pharynx, nose, stomach, skin, vagina/prepuce, or anus/fecal. In addition, lesions which do not heal as expected should be cultured.

Polymerase Chain Reaction. Polymerase chain reaction or reverse transcriptase-PCR is used routinely in medicine for identification of pathogens in a variety of samples. Polymerase Chain Reaction can be performed on blood, tissues (frozen, fixed or embedded), fluids or smears. There are a number of marine mammal pathogens for which we have DNA probes, such as: morbillivirus, influenza virus, and brucella (see Appendix H for a list of recommended diagnostic microbiology laboratories). These techniques may be used, if indicated, to diagnose acute, subclinical or latent infections. Pending the results of ongoing research, it may be recommended as the method of choice for determining whether pathogens are present or are being shed.

Suggested tests are offered as a list of potential pathogens to be considered and possibly tested for in a given situation. These lists will be edited as more information is learned. Table 2 lists pathogens which either have been found in pinnipeds or have the potential to affect pinnipeds. For each pathogen, the table indicates whether the pathogen has historically occurred in pinnipeds, whether testing for the pathogen is recommended, or whether the pathogen should be tested only for monitoring or research purposes. Pathogens that have not historically occurred in pinnipeds, but are thought to have the potential to affect pinnipeds, are also listed. This is to alert rehabilitators to the possibility of such pathogens. Testing will be determined by the on-site veterinarian or may be required or requested by the Services.

Infectious disease considerations to be made in cases of known or new infectious diseases with epizootic potentials. This would also be applicable in die-off situations. These criteria will be used on a disease-by-disease basis.

* Standardized sample collection and testing have been established, and through an agreement with the National Veterinary Services Lab, a performance based Analytical Quality Assurance program [AQA] has also been established. Testing should only be performed in labs which are participating in the AQA (Appendix H).

* Non-exposed animals may be released if they have two negative titers at least two weeks apart, have no history of recent exposure, and are clinically healthy and off medication for at least a week.

* Release of exposed animals (positive titer) in non-endemic areas will be determined on a case-by-case basis.

* Exposed animals in endemic areas
    1) Serial titers to be determined.
    2) Animals with stable or declining titers and no clinical illness - may be released.
    3) Animals with rising titer or which are clinically ill cannot be released until the animal shows full recovery, is off medicine for a minimum of seven days, and exhibits a stable or declining titer (after two consecutive titers at two week intervals). Again, this will be on a case-by-case, region-by-region, or disease-by-disease basis.

E. Cytology. Cytology culture may include sampling from pharynx, nasal, stomach, skin, vagina/prepuce, anus/fecal. In addition, any grossly abnormal areas which do not heal normally should be cultured. Cytological examinations may be used to identify infectious diseases, inflammatory conditions, or tumors.

Summary: The animal must be determined clinically healthy by the staff veterinarian. Prior to certification for release, the animal should be free of drugs used for treatment (the use of sedatives or immobilizing drugs to aid in transport and release may be necessary) for a minimum of one week without presenting any clinical signs of illness. This is to prevent drugs masking signs of disease and to minimize the development of drug resistant microbes. This time span should be scaled (expanded) relative to the nature of the disease organism and the length of time an animal has been given antibiotics.

Table 2. List of Pathogens With the Potential to Affect Pinnipeds.

Pathogen	Historically Found	Testing Recommended	Part of an Ongoing Monitoring/Research Program	Potential for Pathogen to be Present
Viral Diseases				
Morbillivirus	x	x	x	
Herpesvirus	x	x		
Calicivirus	x		x	
Influenza virus	x	x		
Adenovirus	x			
Canine parvovirus				x
Feline panleukopenia				x
Feline infectious peritonitis				x
Poxvirus	x		x	
Bacterial diseases				
Brucella	x		x	
Erysipelas	x			
Leptospira	x	x	x	
Listeria	x			
Salmonella	x			
Mycotic diseases				
Aspergillus	x			
Blastomyces				x
Cryptococcus				x
Coccidioides	x			x
Histoplasma	x			
Parasitic diseases				
Dirofilaria	x	x		
Toxoplasma	x			
Other				
Chlamydia	x			

3.4. Behavioral Considerations

3.4.1. General Behavior

Only the most basic behavioral evaluations are possible in rehabilitation situations. It would be unrealistic to expect the demonstration of anything but a few basic behavior patterns prior to release. The limitations imposed by the captive environment and the lack of knowledge of what constitutes "normal behavior" for many species of marine mammals prohibits extensive behavioral testing.

Before release may be considered, an experienced animal care provider must evaluate whether a pinniped is able to respire, swim, locomote, maneuver, and dive normally. The animal should not demonstrate any obvious aberrant behavior[14] indicating a medical condition or other condition that might be detrimental to its survival in the wild. If the animal's behavior is determined to be normal, then it should continue in its release candidacy evaluation (providing all other natural history, medical, ethical, and logistical criteria are met).

Visual deficits, other sensory problems, and some physical deficits must be evaluated on a case-by-case basis. Anecdotal evidence suggests that some blind pinnipeds may be able to do well in the wild. This capacity appears to be species dependent (Gulland, personal communication). If a visually impaired pinniped is otherwise healthy (shows no infectious diseases and has normal bloodwork) live fish trials should be conducted. If the animal can track, catch, and eat live fish, the animal may be releasable. It should, however, be radio tagged so the animal can be monitored.

Pinnipeds that have been in captivity for an extended period of time (more than a year) or have never lived independently in the wild will need to demonstrate additional behavioral abilities. These behavior tests are designed to determine if they have retained (or have developed) important survival skills, including the ability to capture prey and if possible avoid predators.

3.4.2. Prey Capture Ability

Candidates which have been in captivity for more than a year or which have never caught prey should demonstrate an ability to capture and eat live prey. They should not be required to maintain body weight with live prey as this could unnecessarily delay release. The use of local prey species in feeding trials would be most desirable, but reasonable surrogates would be acceptable.

3.4.3. Predator Recognition and Avoidance

Animals that have previously lived in the wild independent of their mothers do not need to be tested for predator avoidance because they presumably retain their knowledge of risks and

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[14]For more information on abnormal behaviors, please see J. C. Sweeney, "Marine Mammal Behavioral Diagnostics" *in* L. A. Dierauf (ed.), CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation, pp.53-72.

responses associated with predators. Stranded dependent young and wild-conceived, captive born young are presumably at a higher risk of predation because of their lack of experience. Two strategies are possible: these young animals could be released with their wild mother, or released under experimental circumstances after appropriate training has occurred.

3.5. Release

3.5.1. Animal Preparation

Deconditioning behaviors. The potential releasability of a stranded animal should be assessed at the time of arrival at the rehabilitation facility. If an animal is a potential release candidate, it should be isolated from public display animals and, to the extent possible, all unnecessary human contact. No attempts should be made to train potential release candidates, and hand-feeding should be avoided if possible.

In addition, every effort should be made to minimize the time in captivity, however, the duration of captivity must be weighed against animal health and medical treatment. The longer the candidate has been out of the wild, the more time may be required to hone foraging skills and decondition the animal from human interactions. The time needed for such conditioning and for skills acquisition or reacquisition must be carefully weighed against dangers of prolonging rehabilitation.

Minimizing contact may be difficult or even impossible in some cases due to the intensive physical care necessary for rehabilitation. In fact, in some cases, extensive contact with humans may benefit resolution of the medical case by providing needed mental stimulation and behavioral enrichment. If animals can be released in a timely manner, such conditioned behaviors usually are not a concern.

The behaviors of concern are those that would facilitate post-release human contact. Interactions with people in the water and hand-feeding behaviors should be deconditioned if possible prior to release. Most behaviors will extinguish through lack of reinforcement, but some may require more concentrated efforts. The presentation of detailed protocols for deconditioning of behaviors is beyond the scope of this report. These might best be developed through the efforts of a panel of experienced marine mammal trainers. The success of deconditioning can be assessed through observations of the fading of undesirable behaviors.

Marking/tagging. All released animals must be individually identifiable. Therefore, they should be marked or tagged prior to release (this may not be necessary if the animal has natural markings by which it can be identified or already has a research tag). Only with appropriate tagging, monitoring and reporting can scientists determine the success or failure of rehabilitation efforts. Improper tagging of animals can result in tissue damage or infection, therefore tagging should only be done by trained handlers.

There are several methods available to identify released pinnipeds: plastic cattle ear tags; dye, bleach, or paint; and radio transmitters. When marking pinnipeds with plastic tags, otariids should be tagged in their fore flippers (R. Merrick, pers. comm.). The tag should not be placed

so low that the animal will walk on it or so high that it will irritate the flank area (Geraci and Lounsbury 1993, Dierauf 1990). Phocids should be tagged in their hind flippers between their third and fourth digits. Large, plastic tags work well (e.g., Jumbo roto or medium Allflex), can be used on most pinnipeds, and should last 3-4 years. Preferably, rehabilitated animals should be marked with tags that have a distinctive color (e.g., orange) different from those used by researchers tagging healthy animals in the rehabilitated animal's range. Alternatively, the released animal's tag could have an "R" as a first or last character. Numbers on tags should be large enough to be easily read, and should be coordinated through a central database. It is also useful to include the rehabilitation center's address on the back of the tag (R. Merrick, NMFS, pers. comm.). When using dye, paint (quick dry), or bleach, the animal should be marked on top of the head or back. The disadvantage of this method is that markings will only last until the next molt. A more expensive alternative is to mount radio transmitters (satellite or VHF) on a mesh base and attach the unit to the animal's fur using marine epoxy. Radio transmitters are typically placed on the top of the head or between the shoulders. These will also be lost during the next molt (Geraci and Lounsbury, 1993). For walruses, radio transmitters are mounted externally on the animal's tusks.

3.5.2. Logistic Preparation

In all but a few cases, pinnipeds may be released at their stranding site through a simple hard-release process[15]. Consideration should be taken to ensure that the release is timed to allow the individual the best chance for survival. This will vary with the age and sex of the individual. Timing should be set to minimize additional energetic and social demands and maximize foraging success and ease of social acceptance with conspecifics. Members of species with well-defined breeding seasons should not be released until after the completion of the season and during non-estrus periods. Water temperature, salinity, and other environmental factors must be within the range of tolerance of the species at the location and time of release. Ideally release should take place as soon as possible after stranding in order to minimize the duration of time in captivity. All of the above criteria are most easily met with species that are non-migratory.

It may be necessary to hold a migratory animal until the population has returned to the original stranding area. Although it may not be advisable to release an animal just prior to a long and demanding migration, the risks of continued captivity must be weighed against a hazardous migration. Alternatively, the animal might be transported to the location of its population at the time of release, but this would be more logistically complex and expensive. This question should be examined individually on a case-by-case basis.

If possible, release should be timed to match feeding cycles rather than fasting periods. Seasonal fasts should not be a problem, however, as long as the animal has good body stores when it is released.

3.5.3. Release Site Selection

Ideally, the release candidate should be released within its home range, genetic stock, and

[15]Hard release = releasing a rehabilitated animal directly back into its natural habitat with no period of adjustment. In contrast, soft releases include a period of acclimation in a sea pen at the release site and often allow the animal to return once the sea pen has been opened.

social unit. Often, all of this information will not be available. In most cases only the stranding site will be known, and usually there will not be any information on the relationship between the stranding site and the prestranding range of the individual. Therefore the nearest location to the stranding site that is occupied regularly by conspecifics may serve as the release site.

Ideally, rehabilitated pinnipeds should only be returned to the waters and genetic population from which they originated. However, because knowledge of genetic stocks is limited at this time, release into the genetic population of origin cannot be guaranteed. In addition, pinnipeds should be released as far from human populated areas as possible.

Another factor to consider when selecting a release site is resource availability and the condition of the habitat. Rehabilitated animals should not be released into areas known to have depleted resources (IUCN/SSC RSG 1996). If evidence exists of a severe decline in resources or habitat conditions since the time of the stranding (for example, massive fish kills, significant declines in commercial and/or recreational fish landings, etc.), it may not be appropriate to release an animal into the area. Rehabilitators should contact local, state, and federal authorities prior to release to ensure that the conditions at the release site do not pose any known threat to the animal. The animal could be held until conditions improve at the proposed release site, however the urgency of returning a rehabilitated animal to the wild must be weighed against the risk from depleted resources. It may be preferable to consider another site for release.

3.5.4. Monitoring

Post-release monitoring is encouraged for every release of a rehabilitated pinniped. Most of the criteria suggested here are based on few direct data, because little published information is available on the fates of released animals. To meaningfully refine release criteria the agencies should study the fates of released animals. To the extent practicable, monitoring efforts should be rigorous enough to determine the long-term fate of the rehabilitated animal(s).

The level of required monitoring may vary from animal to animal. While large numbers of pinnipeds have been rehabilitated and released, few data are available that show what happened to the animals that are released. It is worthwhile to collect resightings of each opportunistically, as is done currently, and to follow selected individuals closely through telemetry and direct visual observation. These individuals might be selected based on the questions they can answer: for example, how does the level of human interactions prior to release translate into human interactions following release.

Information on the fates of released animals will be processed and made available in order to guide future releases and treatment strategies.

4. RELEASE GUIDELINES FOR STRANDED CETACEANS

4.1. General Information

While it is recognized that all cetaceans are not alike, this document has been generally applied to all odontocetes and provisionally to mysticetes. Until more information is available on mysticete natural history, behavior, and medicine, we cannot adequately address specific mysticete release criteria.

4.2. Natural History Considerations

4.2.1. Age

The age at which an animal was rescued is a concern. Young animals may be more inclined to "forget" their natural survival skills and may be more difficult to release than an older animal held for the same length of time. **Nursing calves, in the absence of their mothers, are not release candidates.** The chances of a neonate finding its group of origin, and of a lactating female bonding with the neonate are remote. These individuals may be identified based on length, weight, presence of umbilical cord or stump, fetal folds, non-erupted teeth, and the absence of solid food in gastric samples.

In the absence of empirical data on the survivability of calves, no odontocete which was nutritionally dependent at the time of stranding, should be released unless it can be released with its mother. These animals probably have not yet developed the skills necessary to find and capture food in the wild, the social skills required to successfully integrate into wild societies, the knowledge of their home range or migratory routes, or predator recognition and avoidance skills. In addition, extensive contact during care-giving may result in a familiarity with humans which might lead to undesirable post-release human contact. In particular, there is as yet little information available on the survivability of rehabilitated mysticete calves. Therefore if any are to be released, they should be permanently marked, tagged and monitored, so release success can be evaluated.

Conversely, very old individuals may not be good release candidates, because homeostatic abilities decline with age. Old age in mammals results in increased difficulty in coping with disease, stress, and change. In addition, recent evidence suggests age-induced hearing decline. An aged animal in captivity for more than a year may be compromised with respect to ability to respond to the great change necessary to reintegrate into a wild existence. Such cases will need to be considered individually.

4.2.2. Morphometrics

The straight length (for growing animals), blubber depth, and weight of an animal should be taken upon entry. Weight measurements should be taken weekly (if possible) throughout the rehabilitation period and prior to release. These measurements will be useful in continued assessment of condition and health status during the rehabilitation period and will provide reference data for release success evaluation.

4.2.3. Reproductive Status

Females in estrus should not be released because males may harass estrus females during the early stages of readjustment to the wild, compromising their ability to forage, increasing stress, and slowing their reintegration into the wild society.

Pregnant animals are releasable, as long as the period of rehabilitation is brief, and the pregnancy or the health of the female is not jeopardized by the release transport or reintegration. If a pregnant female is to be released, then every effort should be made to release her before the third trimester (preferable to spending extended post-partum time in captivity or causing abortion or injury during transport). Staging of pregnancy can be determined using diagnostic ultrasound or in some cases by season of year and condition of the animal.

If a wild-conceived calf is born while a mother is undergoing rehabilitation, then the animals should be kept until the calf is raised to a minimum level of independence. It would be advisable to delay release until such time as the calf has demonstrated its ability to capture and eat live prey, for two reasons: (1) the energetic requirement of lactation may be too high a burden for a mother to manage during the transition to the wild, and (2) the calf would be able to obtain nutrients on its own should the stress of release interfere with lactation, or the mother and calf separate upon release. In perhaps the only documented case of the release of a young bottlenose dolphin calf with its mother, the calf did not survive (Gales and Waples, 1993).

4.3. Medical Considerations

The ultimate goals of the medical evaluation are two fold: to determine that the animal will pose no threat to the wild population if released, and to determine that the animal is healthy and likely to survive in the wild. Medical evaluation to determine release candidacy is done by the experienced staff veterinarian. Medical history, physical examination and clinicopathologic data collection may optimize our ability to determine that an animal is healthy and will pose no threat to wild populations. However, this process does not guarantee this because our knowledge of the disease and disease pathogenesis in marine mammals is incomplete.

4.3.1. History

A good medical history should include site of stranding, status at stranding, cause of stranding, disease history (current, clinical, and serologic), treatment during rehabilitation, developmental history both physical and behavioral, and exposure to disease. If an animal is held with or in close proximity to other animals undergoing rehabilitation, the disease history of penmates/ neighbors must be considered. This is to ensure that the animal has not been exposed to disease while in rehabilitation. Ideally the disease/health history of the population of origin may also be noted.

4.3.2. Physical Examination

The physical examination should include morphometrics, blubber thickness at specific locations and weights as part of the standard, thorough examination. A thorough physical exam should be performed by an experienced marine mammal veterinarian on each animal upon entry, throughout the rehabilitation period, and prior to release. This information will provide reference data for release success evaluation.

4.3.3. Diagnostics

At a minimum, a CBC[16] and serum chemistry panel should be done on admission and it may be done when the Regional Stranding Coordinator is notified of the intent to release to provide information on release candidacy. In addition, these diagnostics should be performed 48-72 hours prior to release to provide information on final medical release candidacy. It is recommended that the facility establish a working relationship with a laboratory and use that laboratory routinely to decrease the laboratory to laboratory variability. A minimum of 3 ml of serum from each sampling must be maintained frozen for possible retrospective studies involving future infectious disease epizootics. This serum will be sent to the Regional serum bank. Table 3 lists cetacean CBC and serum chemistry reference intervals.

[16]Dolphins normally exhibit large platelets. If the laboratory performing the CBC is not aware of this, their electronic cell counters may read the platelets as white blood cells, resulting in erroneous white cell and platelet counts. If there is any doubt, it may be wise to perform the differential and platelet counts manually.

Table 3. Cetacean Hematology, Serum Chemistry and Reference Intervals. From *CRC Handbook of Marine Ma* *Medicine: Health, Disease, and Rehabilitation* (L.A. Dierauf, ed.) unless otherwise noted.

Blood Parameters	Units	Bottlenose dolphin (*Tursiops truncatus*)	Pacific white-sided (*Lagenorhynchus obliquidens*)	Risso's dolphin (*Grampus griseus*)	Gray whale (*Eschrichtius robustus*)	Beluga wh (*Delphinap leucas*)
Complete Blood Count (CBC)						
Erythrocytes						
n=		136	2	81[17]	9	45
RBC	$10^6/mm^3$	2.9-5.4	5.3-5.8	3.8-5.4	3.3	2.9-3.(
Hgb (Hb)	g/dl	14-15[18]	18	14.7-20.3	14	19.7(1.9
PCV	%	41-44[18]	49	41.7-57.6	47.6	53(5)[1
MCV	fl	101-143	85-93	77-152	129	161-18
MCH	pg	34-50	31	27-53	42	63-69
MCHC	g/dl	30-38	37	26-49	33	35-40
Leukocytes						
n=		152	2	82		45
WBC	$10^3/mm^3$	5.6-7.3[18]	6.5-9.5	6-29[18]	n.d.[20]	7.1(1.3
SEGS (neutro)	%	66-75[18]	54-60	54-95	n.d.	58(10)
Bands	%	0-5	0	0-22	n.d	0
Lymphs	%	13-22[19]	20-22	5-41	n.d	29(10)
Monos	%	1-4[18]	2-3	0-4	n.d	7(4)[1

[17] 81 samples from a single individual.

[18]Data from L. Dalton, pers. comm. N=241 for Belugas, n= for Bottlenose dolphins.

[19]Leukocytosis and extreme left shift suggestive of inflammation; mean WBC=10,000±4,800; mean band cell %=2.5±2.0.

[20]n.d.=no data available

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Eos	%	8-15[18]	17-23	0-18	n.d	5(3)[18]
Basos	%	0-3	0	0	n.d	0
			Serum Chemistry			
Liver enzymes and billirubin						
n=		82	2	61		45
SGOT/AST	IU/l	102-133[18]	n.d.	184-516	n.d	76(44)[18]
SGPT/ALT	IU/l	19-34[18]	40-48	51-214	n.d	8(6)[18]
Total bilirubin	mg/dl	0.0-0.1	n.d.	0.0-0.1	n.d.	0.2-0.6
Direct		0.0-0.1	n.d.	0.0-0.1	n.d.	n.d.
Indirect		0.0-0.3	n.d.	0.0-0.2	n.d.	n.d.
GGT	IU/l	20-40[18]	n.d.	9-43	n.d	22(12)[18]
Liver, muscle, and kidney enzymes						
n=			2	57		
CK (CPK)	IU/l	47-74[18]	9-15	48-157 (n=7)	n.d	153(68)[18]
BUN	mg/dl	42-53[18]	n.d.	36-69	n.d	51(7)[18]
Creatinine	mg/dl	1.2-1.5[18]	n.d.	1.4-2.8	n.d	1.4(0.4)[18]
AP	IU/l	204-341[18] (n=135)	n.d.	7-308	n.d	187(83)[18]
LDH/GDH	IU/l	177-216[18]	n.d.	74-732	n.d	181(82)[18]

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Glucose, lipids, and pancreatic enzymes						
n=		118		58		45
Glucose	mg/dl	87-150	n.d.	115-216	n.d.	83-134
Triglycerides	mg/dl	69-108[18]	n.d.	33-327	n.d.	209(141)
Cholesterol	mg/dl	204-272[18]	n.d.	152-566	n.d.	209(141)
Amylase	IU/l	9-20 (n=50)	n.d.	n.d.	n.d.	2-19
Lipase	IU/l	17-665 (n=39)	n.d.	n.d.	n.d.	n.d.
Proteins						
n=		80	2	63		45
Total Protein	g/dl	6.2-8.3	n.d.	6.3-8.0	n.d	5.9-8.0
Albumin	g/dl	2.8-5.6	n.d.	3.5-4.9	n.d	3.5-5.2
Globulin	g/dl	1.1-3.9	n.d.	2.4-4.2	n.d	1.5-3.8
Electrolytes						
Sodium (Na^+)	mEq/l	141-168	161-162	139-159	n.d	n.d.
Potassium (K^+)	mEql	3.5-5.7	3.3-3.7	2.8-10[21]	n.d	n.d.
Chloride(Cl^-)	mEq/l	100-128	n.d.	104-126	n.d	97-11
Calcium (Ca^{++})	mg/dl	7.7-9.7	n.d.	7.6-10.0	n.d	8.2-10.
CO_2	mEq/l	14-31 (n=45)	n.d.	n.d.	n.d	n.d.
Phos	mg/dl	4.1-7.8	n.d.	2.7-9.8	n.d	4.6-7.
Fe	g/dl	110-175 (male, n=50); 143-220 (female)	n.d.	n.d.	n.d	108-4

[21]Mean potassium=3.7±1.0mEq/l

Parasitology

Evaluation of parasite loads is an integral part of the medical evaluation. Many cetaceans have clinical illnesses associated with parasitism and most cetaceans will have evidence of parasitism. This evaluation should include fecal floatation or sedimentation and a direct smear. In addition, diagnostics may include Baerman analysis and blowhole and gastric sampling as determined by the veterinarian. Treatment for subclinical parasitism is discouraged, based on the knowledge of the potential harmful effects of such treatment in other species, and the potential for allowing development of anthelmintic resistant parasites.

B. Urinalysis

Evaluation of urine is a useful diagnostic tool. Some abnormalities seen in the urinalysis may be indicative of urinary tract disease while others may reflect other organ disease processes. Urinalysis should include the following parameters: physical characteristics, chemical characteristics, and sediment examination. These results should be considered in conjunction with blood work and other health indices. If feasible, urinalysis should be performed at admission and as part of the release candidacy evaluation.

C. Immunology

Evaluation of immunological competence prior to release may be important in some cases (see Appendix G for list of tests). Most evaluations for immunological function are still developmental or experimental and are not in common use for more than a few species. Until such time that these tests are developed, become validated and in common use, no specific test will be recommended for general use. Some labs have developed certain tests for specific species which may be used as deemed necessary by the attending veterinarian.

D. Infectious Diseases

In general the methodologies for detecting infectious organisms include serology, isolation, and PCR. Polymerase Chain Reaction can be used to amplify segments of genetic material from minute quantities of organisms or non-growing microbes.

Serology. Serology is principally used to identify pathogens to which the animal has been exposed and is used extensively in retrospective or other epidemiological studies. Serology is rapid and usually easily conducted. In some cases a rising titer can indicate active infection or exposure in individual animals. In addition, serological examination upon admission can guide the care of the animal and examination at release can determine which, if any, pathogens the animal has been exposed to in the facility. Ideally, serological tests should be performed at least twice, once upon admittance and then a minimum of two weeks later prior to release. However in some cases, testing should be delayed upon admittance. It is often difficult to obtain enough blood at admission from an emaciated animal in shock to allow for more than a CBC and chemistry profiles. Sufficient blood may not be obtained until several days after initial admission. In addition, certain stranding situations result in high mortalities. Delaying this type of testing would eliminate expensive testing of animals that die early in rehabilitation. Regardless of whether serological testing is performed at the time of obtaining the sample, blood should be collected and stored. Evaluation of serology may also be delayed in cases where the cause of stranding is more obvious and non-infectious (or when survival is unlikely). Once the pre-release sample is drawn, the samples could be run together, allowing better comparisons and

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deceasing variability. (See Appendix H for lists of diagnostic labs).

Required serological tests for release may be based on a documented incidence of a pathogen(s) or disease(s) in a given geographic area, on the potential for epizootics or on the potential for known or suspected agents to have a significant impact on wild animals or human health.

Microbial culture and isolation (viral, bacterial [anaerobic/aerobic], fungal). Microbial culture, isolation and identification provide a definitive answer to the presence of a microbe; however, failure to isolate the organism in culture does not mean the microbe is not present. Samples may be obtained from the pharynx or oral cavity, blowhole, stomach, skin, vagina/prepuce, or anus/fecal. In addition, any wound which does not heal as expected should be cultured. When indicated by the condition of the animal, cultures and sensitivities may be done to better guide therapeutic actions.

Polymerase Chain Reaction. Polymerase Chain Reaction (PCR) or reverse transcriptase-PCR is used routinely in medicine to identify pathogens in a variety of samples. Polymerase Chain Reaction can be performed on blood, tissues (frozen, fixed or embedded), fluids or smears. There are a number of marine mammal pathogens for which we have DNA probes, such as: morbillivirus, influenza virus, and brucella (see Appendix H for a list of recommended diagnostic microbiology laboratories). This technique may be used if indicated to diagnose acute, subclinical, or latent infections. Pending the results of ongoing research, it may also be recommended as the method of choice for determining whether pathogens are still present or are being shed.

Table 4 offers a list of potential pathogens to be considered and possibly tested for in a given situation. These lists will be edited as more information is learned. Pathogens are listed which either have been found in cetaceans or have the potential to affect cetaceans. For each pathogen, the table indicates whether the pathogen has historically occurred in cetaceans, whether testing for the pathogen is recommended or required, or whether the pathogen should be tested only for monitoring or research purposes. Pathogens that have not historically occurred in cetaceans, but have the potential to affect cetaceans, are also listed. This is to alert rehabilitators to the possibility of such pathogens. Testing will be determined by the on-site veterinarian and/or may be required by the Services.

Table 4. List of pathogens With the Potential to Affect Cetaceans.

Pathogen	Historically Found	Testing Required	Testing Recommended	Part of an Ongoing Monitoring/ Research Program	Potential for Pathogen to be Present
Viral diseases					
Morbillivirus	x	x (W. Coast)	x	x	x
Herpesvirus	x			x	x
Calicivirus	x			x	x
Influenza virus	x				x
Adenovirus	x				x
Poxvirus	x			x	
Bacterial diseases					
Brucella	x		x	x	x
Erysipelothrix	x				x
Mycotic diseases					
Aspergillus	x				x
Blastomyces					x
Cryptococcus					x
Coccidioides					x
Histoplasma	x				x
Parasitic diseases					
Toxoplasma	x				x
Other					
Chlamydia	x				x

Infectious disease considerations to be made in cases of known or new infectious diseases with epizootic potentials. These considerations would also be applicable in die-off situations. These criteria will be used on a disease-by-disease basis.

* Standardized sample collection and serological testing have been established, and through an agreement with the National Veterinary Services Lab, a performance based Analytical Quality Assurance program [AQA] has also been established. Testing should only be performed in labs which are participating in the AQA (Appendix H).

* Non-exposed animals may be released if they have two negative titers at least two weeks apart, have no history of recent exposure, and are clinically healthy and off all therapeutic drugs for at least a week.

* Release of exposed animals (positive titer) in non-endemic areas will be determined on a case-by-case basis.

* Exposed animals in endemic areas
    1) Serial titers to be determined.
    2) Animals with stable or declining titers and no clinical illness - may be released.
    3) Animals with rising titer or that are clinically ill cannot be released until the animal shows full recovery, is off medicine for a minimum of seven days, and exhibits a stable or declining titer (after two consecutive titers at two week intervals). Again, this will be on a case-by-case, region-by-region, or disease-by-disease basis.

E. Cytology. Cytologic evaluation may include sampling from the pharynx/oral cavity, blowhole, stomach, skin, vagina/prepuce, or anus/fecal. In addition, any areas which do not heal as expected should be examined. Cytological examinations may be used to identify infectious diseases, inflammatory conditions, or tumors.

Summary: The animal must be determined clinically healthy by the staff veterinarian. Prior to certification for release, the animal should be free of therapeutic drugs used for treatment for a minimum of one week without presenting any clinical signs of illness. This is to prevent drugs from masking signs of disease and to minimize the development of drug resistant microbes. The time span should be scaled (expanded) relative to the nature of the disease organism and the length of time an animal has been given antibiotics.

4.4. Behavioral Considerations

4.4.1. General Behavior

It would be unrealistic to expect the demonstration of anything but a few basic behavior patterns prior to release. The limitations imposed by the captive environment and a lack of knowledge of what constitutes "normal" behavior for many cetaceans makes detailed behavioral evaluations nearly impossible. In one of the few cases in which the behavior of released dolphins was quantified both before and after release, significant differences in activities were observed between captivity and the wild (Bassos 1993).

Therefore, if a cetacean is able to respire, swim, maneuver, and dive normally and does not demonstrate any obvious aberrant behavior[22], then it will be a candidate for release. If aberrant behavior is identified, the candidate should not be released without further testing or deliberations.

Visual deficits, auditory deficits, other sensory problems, and some physical deficits must be evaluated on a case-by-case basis. Live fish trials should be conducted with visually impaired animals. If the animal is able to track, capture, and eat live prey, the animal will be considered a release candidate (provided the animal is otherwise healthy).

Cetaceans which have been in rehabilitation for more than a year, or which have not lived in the wild independently, will need to demonstrate behavioral abilities beyond swimming, maneuvering, diving, and respiring. Additional behavioral evaluations should be conducted to determine if these animals have the skills necessary to survive in the wild.

4.4.2. Prey Capture Ability

If evidence is available to indicate that a release candidate has been foraging successfully in the wild prior to stranding, and if the time in captivity is less than one year, then simple demonstration that the animal can recognize, capture and consume live prey is sufficient. In long term cases, some demonstration of prey capture ability is necessary, with the recognition that experiments involving capture of live prey within a captive setting are limited and must be regarded as such.

When available information suggests that a release candidate may have limited prior foraging experience, then more stringent tests are required. Monitoring in the wild could be considered as an alternate to live prey experiments, but should be limited to animals which could conceivably be recaptured (such as inshore species like coastal bottlenose dolphins) should weight loss/failure to thrive threaten the animal's survival.

4.4.3. Predator Recognition and Avoidance

The need for demonstration of predator recognition and avoidance abilities varies with the age and pre-stranding experience of the individual. Animals that have previously lived in the wild independent of their mothers do not need to be tested for predator avoidance because they presumably retain their knowledge of risks and responses associated with predators.

Stranded, dependent young and wild-conceived, captive born young are presumably at a higher risk of predation. These young animals should not be released, except with their wild mother. If this is not possible, it may be necessary to accept the risk of predation, and conduct an experimental release to gather information for future release decisions.

4.5. Release

[22]For more information on abnormal behaviors, please see J. C. Sweeney, "Marine Mammal Behavioral Diagnostics" *in* L. A. Dierauf (ed.), CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation, pp.53-72.

4.5.1. Animal Preparation

Deconditioning behaviors. If animals can be released in a timely manner, conditioned behaviors should not be a concern. Many experts are of the opinion that the longer an animal is maintained in a captive environment, the less likely it is that reintroduction will be successful. However there have been no studies confirming this. The longer an animal is in captivity, the more it may feel comfortable with people, and therefore require more deconditioning.

In order to prevent the acquisition of unnatural behaviors, interactions with humans should be kept to a minimum, and limited to such activities as force-feedings, treatments, etc. In addition, hand-feeding should be avoided. Minimizing contact may be difficult or even impossible in some cases, however, due to the intensive physical care necessary for rehabilitation. In some cases, extensive contact with humans, including training, may benefit resolution of the medical case by providing mental stimulation and behavioral enrichment, and by facilitating medical procedures. The relative costs and benefits of training should be evaluated by the staff veterinarian, and should consider the likelihood of contact with humans following release (some offshore species or stocks are extremely unlikely to come into contact with humans in the wild).

If an animal has become accustomed to hand-feeding or boat-following, the animal may approach humans after release. Therefore, these behaviors should be deconditioned before the animals can be considered for release. Most behaviors will extinguish through lack of reinforcement, but some may require more concentrated efforts. The success of deconditioning can be assessed through observations of the fading of undesirable behaviors.

Marking/tagging. All release candidates should be marked in such a way as to be easily identifiable. Determining whether a release has been successful requires the ability to re-identify the individual, therefore, animals must be marked (Llewellyn and Brian,). Although the least intrusive method for identifying animals is to note (and photograph) natural markings (such as unusual fin or fluke shapes, scars, etc.), this may not be sufficient in most cases to allow field identification or monitoring of the animal. Improper tagging methods can result in tissue damage and/or infection, so training and experience are required to apply these techniques.

One tagging technique is freeze branding, which should be done on the dorsal fin or on the animal's side just below the dorsal fin. Freeze branding provides long-lasting marks that can be seen from a distance. Large plastic cattle ear tags can also be used for identification, and should be attached through the trailing edge of the dorsal fin. These tags typically last several months. Freeze branding cetaceans is preferred over plastic tags because of the permanence of this tagging method.

Satellite or VHF tags can also be used to monitor the success of a released cetacean. Mounting satellite tags on cetaceans can be done in some species by bolting a "saddle" through the dorsal fin. Radio tags are also placed in the dorsal fin. These can be attached with corrosible bolts and may last 10-12 weeks.

4.5.2. Logistic Preparation

In coastal situations, it may be advantageous to conduct a soft release, in which the

animal is provided with a half-way house sea pen at the release site. The animal would be acclimated in the sea pen prior to release, released, and then left with the option of returning as necessary over the first few weeks, while human interactions are decreased. The benefits of such a release might be greater for animals for which the range of origin is known with less confidence than for known residents of the area. The soft release provides the animal the opportunity to gradually familiarize itself with the environment, and it provides the release team with a means to monitor the animal's condition. It also ensures that a temporary holding facility is available at the release site should the animal fail to thrive during the initial critical period. For offshore species, soft release may not be an option. In these cases, the controlled half-way house situation may be replaced with close monitoring or tracking during the critical initial period following release, coupled with a contingency plan to recover the animal if it should fail to thrive.

Consideration should be taken to ensure that the release is timed to allow the individual the best chance for survival. This will vary with the age and sex of the individual. Timing should be set to minimize additional energetic and social demands and maximize foraging success and ease of social acceptance with conspecifics. Members of species with well-defined breeding seasons should not be released until after the completion of the season and during non-estrus periods. Water temperature, salinity, and other environmental factors must be within the range of tolerance of the species at the time of release. Ideally, release should take place as soon as possible after stranding in order to minimize the duration of time out of the wild. These criteria are most easily met with species that are non-migratory.

It may be necessary to hold a migratory animal until the population has returned to the original stranding area. It would be unwise to release an animal just prior to a long and demanding migration or in water which is too cold. Alternatively, the animal might be transported to the location of its population at the time of release, but this may be more logistically complex and expensive. This decision will have to be made on a case-by-case basis.

Species which have a feast-fast cycle should be released during feeding rather than fasting periods. Seasonal fasts should not be a problem, however, as long as the animal has good body stores when released.

Depending on the life history of the species, social units should be maintained whenever possible. Cetaceans stranded together should be released together. Because much of cetacean behavior is learned, juveniles should be released with adults or in the presence of conspecifics.

4.5.3. Release Site Selection

Ideally, the release candidate should only be released within its home range, genetic stock, or social unit. In most cases, however, only the stranding site will be known, and there will not be any information available on the relationship between the stranding site and the individual's pre-stranding ranging patterns or its social unit. In that case, the nearest location to the stranding site that is occupied regularly by conspecifics (ideally, of the same genetic stock) should serve as the release site. Pelagic cetaceans should be released offshore into habitat known to be occupied by conspecifics at that time of year.

For an animal such as a coastal resident bottlenose dolphin, returning it to its exact home range may be extremely important (Wells et al. 1998). For widely-ranging species such as pilot whales the genetics may be more panmictic and the obligation to be site specific may be less critical. In some cases, it may be possible to identify the pre-stranding home range (area of regular daily usage) based on such data as photographic identification records. A return to familiar waters of a home range is preferable as it may facilitate a successful reacclimation to the wild (the animal will presumably have knowledge of available resources, potential predators, environmental features, and social relationships).

Other factors to consider when selecting a release site are available resources and the condition of the habitat. If possible, rehabilitated animals should not be released into areas known to have depleted resources or habitat. Rehabilitators should ensure that conditions at the release site do not pose any obvious threat to the released animal. If evidence exists of a severe decline in resources or an alteration of habitat quality since the time of the stranding (for example, massive fish kills, significant declines in commercial and/or recreational fish landings, red tides, etc.), it may not be appropriate to release an animal until the resource situation shows improvement or until another suitable site is found. The urgency of returning a rehabilitated animal to the wild must be weighed against the risk from depleted resources and the possible duration and cause of the depletion.

4.5.4. Monitoring

Every release of a rehabilitated cetacean should include some post-release monitoring. Most of the criteria suggested here are based on few direct data, because little published information is available on the fates of released animals. To meaningfully refine release criteria the agencies should study the results of the actions taken experimentally.

It is extremely important that cetaceans be marked, radio and/or satellite tagged and, if at all possible, visually monitored when released to determine their fates and to be able to recover the animals should they fail to thrive on their own. When possible, cetaceans should be monitored through direct observation on a daily basis for at least the first month following release. For pelagic species, this is encouraged, though often cost prohibitive and impractical. The first month is the critical period during which it will become evident whether the animal is capturing sufficient prey, or is being accepted by conspecifics. For coastal species, monitoring should continue on a regular basis through all seasons for at least one full year. During this time, telemetry for coastal and pelagic species should be used to the extent possible and necessary. Data collection protocols for monitoring should be standardized to facilitate the comparison of individual cases.

Information on the fates of released animals will be processed and made available expeditiously in order to guide future releases. Regional Stranding Coordinators will provide information on release efforts to the National Stranding Coordinator, who will process this information and make it available to the stranding network.

5. RELEASE GUIDELINES FOR STRANDED SEA OTTERS

5.1. General Information

While it is recognized that there are differences between some geographic stocks, this document should apply to all sea otters.

5.2 Natural History Considerations

5.2.1. Time in Rehabilitation

There are general limitations (i.e., years), but the releasability of an otter is more related to its ability to survive on its own after release, regardless of the length of time it has been out of the wild.

Injured or ill juvenile or adult otters appear to be able to forage and reproduce normally following release, even after several months of rehabilitation. The effects of keeping an otter for more than one year are not known, but the probability of needing to hold a juvenile or adult for more than several weeks is small. Currently, any sea otter kept more than two years is considered unreleasable.

Young orphaned pups that are not raised for release[23] should not be released, regardless of time spent in captivity.

5.2.2. Age

There are no age classes that should be considered non- releasable. Rehabilitated orphaned pups that were very young when they were obtained can be released in some cases (however foraging testing is required). Some pups are able to develop adequate foraging and survival skills, while others are not. Pups that are older when they are orphaned (> 3 or 4 months) appear to have better-developed foraging skills and have a better chance of surviving after release.

5.2.3. Morphometrics

A complete set of morphometrics should be taken on each animal upon entry, throughout the rehabilitation period, and prior to release. These measurements will be useful in continued assessment of condition and health status during the rehabilitation period and will provide reference data for release success evaluation.

5.2.4. Reproductive Status

Animals of all reproductive states should be considered releasable.

5.3. Medical Considerations

The ultimate goals of the medical evaluation are two fold: to determine that the animal will pose

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[23]Raised for release = minimizing tendencies to imprint on humans and participating in a surrogate mother program in which pups swim in the ocean and learn foraging skills.

no threat to the wild population if released, and to determine that the animal is healthy and likely to survive in the wild. Medical evaluation to determine release candidacy is done by the experienced staff veterinarian. Medical history, physical examination and clinicopathologic data collection may optimize our ability to determine that an animal is healthy and will pose no threat to wild populations. However, this process does not guarantee this because our knowledge of the disease and disease pathogenesis in marine mammals is incomplete.

5.3.1. History

A good medical history should include as much known information as possible on the animal. This includes status at stranding, cause of stranding, disease history, exposure to disease/treatment during rehabilitation, exposure to other animals, and developmental history both physical and behavioral. Ideally this would include disease and health histories of the population of origin.

5.3.2. Physical Examination

The physical examination should include morphometrics and weights, in addition to a standard, thorough examination. A thorough physical exam should be performed on each animal upon entry, throughout the rehabilitation period, and prior to release. Only animals that are clinically healthy should be considered further for release.

5.3.3. Diagnostics

At a minimum, a CBC and serum chemistry panel should be done on admission and prior to release to provide information on medical release candidacy. A minimum of 3 ml of serum from each sampling must be maintained frozen by each facility for possible retrospective studies involving future infectious disease epizootics. Table 5 lists southern sea otter CBC and serum chemistry reference intervals.

Table 5. Sea Otter Hematology and Serum Chemistry and Reference Intervals. From *CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation* (L.A. Dierauf, ed.).

Blood Parameters	Units	Sea Otter (*Enhydra lutris*)
Complete Blood Count (CBC)		
Erythrocytes (n=102)		
RBC	$10^6/mm^3$	3.21-6.54
Hgb (Hb)	g/dl	10.8-22.9
PCV	%	33-70
MCV	fl	82-129
MCH	pg	27-37
MCHC	g/dl	31-38
Leukocytes (n=102)		
WBC	$10^3/mm^3$	5.2-21.6
SEGS (neutro)	%	37-84
Bands	%	0
Lymphs	%	13-61
Monos	%	1-7
Eos	%	1-6
Basos	%	0
Serum Chemistry		
Liver enzymes and bilirubin (n=103)		
SGOT/AST	IU/l	500 max
SGPT/ALT	IU/l	33-366
Total bilirubin Direct Indirect	mg/dl	n.d.[24]
GGT	IU/l	n.d.
Liver, muscle, and kidney enzymes (n=103)		
CK (CPK)	IU/l	490 max
BUN	mg/dl	25-101
Creatinine	mg/dl	0.3-3.9 (n=99)
Uric acid	mg/dl	n.d.

[24] n.d.=no data available.

Blood Parameters	Units	Sea Otter (*Enhydra lutris*)
Liver, muscle, and kidney enzymes (n=103) (continued)		
AP	IU/l	27-714
LDH/GDH	IU/l	419 max
Glucose, lipid, and pancreatic enzymes (n=103)		
Glucose	mg/dl	60-237
Triglycerides	mg/dl	n.d.
Cholesterol	mg/dl	97-414
Amylase	IU/l	7-706
Lipase	IU/l	10-228
Proteins (n=103)		
Total Protein	g/dl	4.3-11.6
Albumin	g/dl	1.2-5.0
Globulin	g/dl	3.1-6.6
Electrolytes (n=103)		
Sodium (Na^+)	mEq/l	139-163
Potassium (K^+)	mEq/l	4.0-5.6
Chloride (Cl^-)	mEq/l	95-120
Phos	mg/dl	3.3-14.4
Calcium (Ca^{++})	mg/dl	5.4-14.5
CO_2	mEq/l	n.d.

A. Parasitology

Evaluation of parasite loads is an integral part of the medical evaluation. Many sea otters have clinical illnesses associated with parasitism. This evaluation should include fecal floatation or sedimentation and a direct smear. In addition, diagnostics may include Baerman analysis or gastric sampling as determined by the veterinarian. Treating for subclinical parasitism should be discouraged, based on knowledge of the harmful effects of such treatments in other species. A concentration heartworm test (Knott's procedure or Filter test) should be done to screen for microfilaria. If microfilaria are found, they should be identified as to species using morphometrics and other standard means of identification.

B. Urinalysis

Evaluation of urine is a useful tool for evaluating sick animals. Some abnormalities seen in the urinalysis may be indicative of urinary disease while others may reflect other organ disease processes. Urinalysis should include the following parameters: physical characteristics, chemical characteristics, and sediment examination. These results should be considered in conjunction with blood work and other health indices.

C. Immunology

Evaluation of immunological competence prior to release may be important in some cases (see Appendix G for list of tests). Most evaluations for immunological function are still developmental or experimental and are not in common use for more than a few species. Until such time that these tests are developed, become validated, and are in common use, no specific test will be recommended for general use. Some labs have developed certain tests for specific species which may be used as deemed necessary by the attending veterinarian.

D. Infectious diseases

In general the methodologies for detecting infectious organisms include serology, PCR, and isolation. Polymerase Chain Reaction can be used to amplify segments of genetic material from minute quantities of organisms or non-growing microbes.

Serology. Serology is principally used to identify pathogens to which the animal has been exposed and is used extensively in retrospective or other epidemiological studies. Serology is rapid and usually easily conducted. In some cases a rising titer can indicate active infection or exposure in individual animals. In addition, serological examination upon admission can guide the care of the animal and examination at release can determine which, if any, pathogens the animal has been exposed to in the facility. Ideally, serological tests should be performed at least twice, once upon admittance and then a minimum of two weeks later prior to release. However in some cases, testing should be delayed upon admittance. It is often difficult to obtain enough blood at admission from an emaciated animal in shock to allow for more than a CBC. Sufficient blood may not be obtained until several days after initial admission. In addition, certain stranding situations result in high mortalities (e.g. heavily oiled animals). Delaying testing would eliminate expensive testing of animals that die early in rehabilitation. Evaluation of serology may also be delayed in cases where cause of stranding is more obvious and non-infectious (or when survival is unlikely). Once the pre-release sample is drawn, the samples can be run together, allowing more accurate and reliable results.

Required serological tests for release may be based on a documented incidence of a pathogen(s) or disease(s) in a given geographic area, on the potential for epizootics or on the potential for known or suspected agents to have a significant impact on wild animals or human health.

Microbial culture and isolation (viral, bacterial [aerobe, anaerobe], fungal). Microbial culture, isolation and identification provides a definitive answer to the presence of a microbe; however, failure to isolate the organism in culture does not mean the microbe is not present. When indicated by the condition of the animal, cultures and sensitivities may be done to better guide therapeutic actions.

Polymerase Chain Reaction. Polymerase Chain Reaction (PCR) or reverse transcriptase-PCR is used routinely in medicine to identify pathogens in a variety of samples. Polymerase Chain Reaction can be performed on blood, tissues (frozen, fixed or embedded), fluids or smears. There are a number of marine mammal pathogens for which we have DNA probes, such as: morbillivirus, influenza virus, and brucella (see Appendix H for a list of recommended diagnostic microbiology laboratories). This technique may be used if indicated to diagnose infection. Pending the results of ongoing research, it may be recommended as the method of choice for determining whether pathogens are present or are being shed.

Table 6 offers a list of potential pathogens to be considered and possibly tested for in a given situation. These lists will be edited as more information is learned. Pathogens are listed which either have been found in sea otters or have the potential to affect sea otters. For each pathogen, the table indicates whether the pathogen has historically occurred in sea otters, whether testing for the pathogen is recommended, or whether the pathogen should be tested only for monitoring or research purposes. Pathogens that have not historically occurred in sea otters, but have the potential to affect sea otters, are also listed. This is to alert rehabilitators to the possibility of such pathogens. Testing will be determined by the on-site veterinarian and may be required by the Services.

Table 6. List of pathogens with the potential to affect sea otters.

Pathogen	Historically Found	Testing Required	Testing Recommended	Part of an Ongoing Monitoring/Research Program	Potential for Pathogen to be Present
Viral diseases					
Canine parvovirus					x
Canine adenovirus					x
Aleutian disease					x
Influenza virus					x
Feline panleukopenia					x
Calicivirus					x
Feline infectious peritonitis					x
Canine morbillivirus					x
Herpes virus					x
Bacterial diseases					
Brucella	x			x	
Pseudotubercula	x				
Leptospira					x
Mycobacterium	x				
Erysipelas					x
Mycotic diseases					
Aspergillus					x
Blastomyces					x
Cryptococcus					x
Coccidioides	x				x
Histoplasma					x
Parasitic diseases					
Toxoplasma					x

Infectious disease considerations to be made in cases of known or new infectious diseases with epizootic potentials. This would also be applicable in die-off situations. These criteria will be used on a disease-by-disease basis.

* Standardized sample collection and testing has been established, and through an agreement with the National Veterinary Services Lab, a performance based Analytical Quality Assurance program (AQA) has also been established. Testing should only be performed in labs which are participating in AQA Appendix H.

* Non-exposed animals may be released (if they have two negative titers at least two weeks apart, have no history of recent exposure, and are clinically healthy and off medication for at least a week).

* Release of exposed animals (positive titer) in non-endemic areas will be determined on a case by-case basis.

* Exposed animals in endemic areas
    1) Serial titers to be determined.
    2) Animals with stable or declining titers and no clinical illness - may be released.
    3) Animals with rising titer or which are clinically ill cannot be released until the animal shows full recovery, is off medicine for a minimum of seven days, and exhibits a stable or declining titer (after two consecutive titers at two week intervals). Again, this will be on a case-by-case, region-by-region, or disease-by-disease basis.

E. Cytology. Cytology culture may include sampling from the pharynx, nose, stomach, skin, vagina/prepuce, or anus/fecal. In addition, any grossly abnormal areas which do not heal as expected should be cultured. Cytological examinations may be used to identify infectious disease, inflammatory conditions, or tumors.

Summary: The animal must be determined clinically healthy by the staff veterinarian. Prior to certification for release, the animal should be free of drugs used for treatment (the use of sedatives or immobilizing drugs to aid in transport or release may be necessary, however) for a minimum of seven days without presenting any clinical signs of illness. This time span should be scaled (expanded) relative to the nature of the disease organism and the length of time an animal has been given antibiotics.

5.4. Behavioral Considerations

5.4.1. General Behavior

Before release, rehabilitated adult and juvenile animals should be able to demonstrate basic swimming and grooming skills, which is rarely a problem for older rehabilitated otters. Rehabilitated orphaned otter pups should also be able to show adequate grooming, swimming, and diving skills. Pups usually appear to develop satisfactory grooming skills, but seem to have the most trouble in developing foraging skills.

5.4.2. Prey Capture Ability

Adult and juvenile release candidates presumably have adequate foraging abilities, and in most cases no demonstration should be necessary. However, when the release candidate arrives at the rehabilitation facility as a young orphaned pup, such a demonstration should be required. The otter should be required to maintain (or increase) its body weight through foraging when it nears weaning age (20-30 lbs) for several weeks. **The most critical requirement for orphaned pups for survival after release appears to be the development of adequate foraging skills.** The only way to test foraging ability is by observing the pup's skills in a natural environment (near shore waters/kelp forests). There is no way to test foraging skills if the pup is living in a tank, or even an exhibit. Thus, while considerable data exist on diet and foraging success in wild pups, there is no known way to test and compare the diving success and diet of rehabilitated pups with that of wild pups. Individual otters have specialized diets and foraging strategies that, at the least, appear to pass matrilineally to daughters.

5.4.3. Social Abilities

This is difficult to test before the animal is released. Adult and juvenile otters should already have normal social skills, but orphaned pups may not. As an alternative to testing at the rehabilitation facility, the social behavior of rehabilitated otters post-release could be compared to the substantial quantity of data available on wild otter social organization and behavior. To date, no obvious abnormal social interactions between released rehabilitated otters and wild otters have been observed.

While orphaned pups are being rehabilitated, it should help to promote normal social interactions, to minimize opportunities to imprint on humans, and to encourage interactions with wild otters during swims in the ocean with surrogate mothers. It should also help to raise orphaned pups with other rehabilitating otters, when possible.

5.4.4. Predator Recognition and Avoidance

This is not a critical test for sea otters. Adults and juveniles presumably already have these skills. Great white sharks are the only natural predator in California waters. Coyotes, brown bears, killer whales, and bald eagles sometimes prey on otters in Alaska, and brown bears cause considerable otter mortality in some areas of Russia. There are no practical ways to test whether orphaned pups can recognize and avoid these predators.

5.5. Release

5.5.1. Animal Preparation

Deconditioning behaviors. Young orphaned pups sometimes "imprint" on humans and continue to interact with people after they are released, although this is not always the case. Many released otters do not interact with humans. Otter-human interactions could be dangerous for humans if the otter were to bite someone (whether intentional or play) and for rehabilitated otters if they approached someone who is hostile towards otters (some otters are shot by people). Sea otters that display any tendency of having imprinted on humans or are attracted toward humans should not be released.

It is helpful to avoid the problem of otters developing inappropriate behaviors toward humans in the first place, because deconditioning may not always work. It may help to

minimize human contact with orphaned pups, except with surrogate mothers who must groom and feed the pup. All "training sessions" with orphaned pups (swimming in the ocean) should be conducted away from onlookers.

Deconditioning (creating an aversion toward humans) could involve a variety of aversive training tactics when the pup is near weaning age and ready for release. Assessing deconditioning is difficult, but general avoidance of (or lack of approach toward) humans would be criteria. Sometimes the otter must be released before its behavior toward humans can be determined.

Marking/Tagging. All released animals should be clearly marked prior to release. Passive Integrated Transponder (PIT) tag systems should be used for standardized identification.

5.5.2. Logistic Preparation

There are a few concerns regarding the timing of release for sea otters since breeding and all activities take place throughout the year. Sea otters in California are especially aseasonal with respect to reproductive events. In all but a few cases sea otters may be released at their stranding site through a simple hard-release process (releasing the animal to immediate independence; providing no period of re-acclimation).

5.5.3. Release

Site selection. Otters should only be released within the same genetic stock. Concerns about artificial genetic mixing are important. When it can be determined, and when practical, the otter should be released within its home range. If the otter is not tagged (tags provide information on home range) or is orphaned, it may be assumed that the otter was living near where it was found. Therefore, under most circumstances, rehabilitated adults, juveniles and pups should be released near where they were found. However, if post-release research is being conducted on these animals (to determine survival rates, foraging behavior, etc), and researchers cannot observe in the more remote portions of the range, then releasing the animal in a more accessible area should be considered. Evidence suggests that sea otters have excellent "homing" abilities, and will swim back to the area in which they originated, sometimes covering hundreds of miles. Regarding southern sea otters in California, young rehabilitated males often swim to male areas in the northern part of their range.

Extralimital animals should be released where they were found under most circumstances. If the otter is rescued from a political "non-otter zone" south of Point Conception, then it cannot be returned to that area.

Resource availability at release site. It probably is not necessary to assess resource availability for California sea otters at the present time, as the food resources appear to be relatively evenly distributed throughout most of the range. In areas where catastrophic events have occurred, more detailed assessments should be done.

Condition of habitat at release site. Under all circumstances an evaluation of the release site should be made; however, the likelihood is that the release environment will not have changed over the time period of rehabilitation (maximum = about 6-9 months). In the case of an

oil spill or comparable event, it should be determined that there is no further danger of contamination (even through ingestion of contaminated prey).

5.5.4. Monitoring

Post-release monitoring should be a requirement for every release of a rehabilitated marine mammal. Most of the criteria suggested here are based on few direct data, because little information is available on the fates of released animals. The only way to meaningfully refine release criteria is to learn the results of the actions taken experimentally. For northern sea otters, the first priority should be to release them near the area where they were captured (since most of Alaska is 'remote'), with secondary regard for post-release monitoring.

Information on the fates of released animals will be processed and made available expeditiously in order to guide future releases.

6. RELEASE GUIDELINES FOR STRANDED SIRENIANS

6.1 General Information

The following release guidelines apply to both subspecies of the West Indian manatee, the Florida manatee (Trichecus manatus latirostris) and the Antillean manatee (T.m. manatus). Consultations for the release of manatees are made with the FWS manatee recovery coordinator. Criteria have been established to determine manatee releasability.

6.2 Natural History Considerations

6.2.1 Size

Manatees smaller than 200 cm will not be released (except calves that were captured with their mothers). If the mother and calf are releasable, a calf of this size may be released with its mother. Manatees between 200 and 275 cm in length are marginal release candidates and will be considered on an individual basis. Animals greater than 275 cm rank highest in terms of releasability. Size is significant because large animals will fare better in cooler weather and can handle a wider range of food items.

6.2.2 Origin

Wild-reared manatees are the best release candidates. Animals raised in captivity from an early age are less suitable for release; these animals may be foster or hand-reared. Foster-reared calves are thought to be more easily releasable than hand-reared calves. Manatees are evaluated for release on a case-by-case basis. Less suitable release candidates may require additional preparation prior to being released and should be tracked when released.

6.2.3 Time in rehabilitation

This amount of time a manatee spends in rehabilitation will influence release decisions. Animals that have spent less than one year in captivity are considered to be the best release candidates. Manatees that have been in captivity longer than a year will be considered for release on a case-by-case basis. Less suitable release candidates may require additional preparation prior to being released and should be tracked when released.

6.2.4 Morphometrics

The straight length, girths, blubber measurements, and weight of an animal should be taken upon entry and during the rehabilitation period. These measurements will be useful in the continued assessment of condition and health status and will provide reference data for release success evaluation.

6.2.5 Reproductive Status

Because of problems that may be associated with transporting and reintroducing pregnant manatees and manatees in estrus, these animals must be carefully evaluated when being considered as release candidates.

6.3 Medical Considerations

The ultimate goal of the medical evaluation is twofold: to determine that the animal will pose no threat to the wild population if released and to determine that the animal is healthy and likely to survive in the wild. Medical evaluation to determine release or non-release is done by rehabilitation program facility veterinarians. Medical history, physical examination and clinicopathologic data collection may optimize our ability to determine that an animal is healthy and will pose no threat to wild populations. However, this process does not guarantee this because our knowledge of the disease and disease pathogenesis in marine mammals is incomplete.

6.3.1 Medical History

A good medical history should include a description of the stranding site, condition at stranding, cause of stranding, disease history, treatment received during rehabilitation, documentation of physical and behavioral developmental history and exposure to disease.

6.3.2 Physical examination

A rescued manatee should receive a physical examination during triage, upon admittance to a treatment facility, and throughout the rehabilitation period. Information gathered during the exams will be used with the animal's medical history and diagnostic tests to determine releasability.

6.3.3 Diagnostics

At a minimum, a CBC and serum chemistry should be done upon admission and prior to release to provide information on medical release candidacy. A minimum of 3 ml of frozen serum from each sampling must be maintained for possible retrospective studies involving future infectious disease epizootics. Table 7 lists normal manatee CBC and serum chemistry ranges.

Table 7. Manatee Hematology and Serum Chemistry and Reference Intervals. From *CRC Handbook of Marine Mammal Medicine: Health, Disease, and Rehabilitation* (L.A. Dierauf, ed.).

Blood Parameters	Units	Manatee *(Trichechus manatus)*
	Complete Blood Count (CBC)	
Erythrocytes (n=30)		
RBC	$10^6/mm^3$	2.3-3.8
Hgb (Hb)	g/dl	9.9-12.6
PCV	%	30-40
MCV	fl	115-139
MCH	pg	36-45
MCHC	g/dl	30-36
Leukocytes (n=20)		
WBC	$10^3/mm^3$	4.5-13.1
SEGS (neutro)	%	30-84
Bands	%	0-1
Lymphs	%	16-46
Monos	%	0-3
Eos	%	1-6
Basos	%	0
	Serum Chemistry	
Liver enzymes and bilirubin (n=15)		
SGOT/AST	IU/l	0-84
SGPT/ALT	IU/l	2-40
Total bilirubin Direct Indirect	mg/dl	0.0-0.2 0.0-0.0 0.0-0.2
GGT	IU/l	21-56
Liver, muscle, and kidney enzymes (n=21)		
CK (CPK)	IU/l	18-729
BUN	mg/dl	0-21
Creatinine	mg/dl	0.9-3.0
AP	IU/l	56-216

Blood Parameters	Units	Manatee *(Trichechus manatus)*
Liver, muscle, and kidney enzymes (n=21) (continued)		
LDH/GDH	IU/l	230-772
Glucose, lipid, and pancreatic enzymes (n=27)		
Glucose	mg/dl	90-189
Triglycerides	mg/dl	n.d.[25]
Cholesterol	mg/dl	77-396
Amylase	IU/l	1493-3900 (n=24)
Lipase	IU/l	105-496 (n=24)
Proteins (n=25)		
Total Protein	g/dl	5.8-8.4
Albumin	g/dl	2.6-6.2
Globulin	g/dl	1.5-3.3
Electrolytes (n=25)		
Sodium (Na^+)	mEq/l	134-158
Potassium (K^+)	mEq/l	4.1-6.5
Chloride (Cl^-)	mEq/l	86-124
Phos	mg/dl	3.4-6.3
Calcium (Ca^{++})	mg/dl	8.2-11.1
CO_2	mEq/l	25-43

[25] n.d.=no data available.

A. Parasitology

Evaluation of parasite loads is an integral part of the medical evaluation. This evaluation should include fecal floatation or sedimentation and a direct smear. In addition, diagnostics may include Baerman analysis or gastric sampling as determined by the veterinarian. Treating for subclinical parasitism is discouraged, based on the knowledge of the harmful effects of such treatment in other species, and the potential for allowing development of anthelmintic resistant parasites.

B. Urinalysis

Evaluation of urine is a useful tool for evaluating sick animals. Some abnormalities seen in the urinalysis may be indicative of urinary disease while others may reflect other organ disease processes. Urinalysis should include the following parameters: physical characteristics, chemical characteristics, and sediment examination. These results should be considered in conjunction with blood work and other health indices.

C. Immunology

Evaluation of immunological competence prior to release may be important in some cases (see Appendix G for list of tests). Most evaluations for immunocompetency are still developmental or experimental and are not in common use for more than a few species. Until such time that these tests are developed, become validated and are in common use for a wider range of species, no specific test will be recommended for general use. Some labs have developed certain tests for specific species which may be used as deemed necessary by the attending veterinarian.

D. Infectious diseases

In general the methodologies for detecting infectious organisms include serology, isolation, and PCR. Polymerase Chain Reaction can be used to amplify segments of genetic material from minute quantities of organisms or non-growing microbes.

Serology. Serology is principally used to identify pathogens to which the animal has been exposed and is used extensively in retrospective or other epidemiological studies. Serology is rapid and usually easily conducted. In some cases a rising titer can indicate active infection or exposure in individual animals. In addition, serological examination upon admission can guide the care of the animal and examination at release can determine which, if any, pathogens the animal has been exposed to in the facility. Ideally, serological tests should be performed at least twice, once upon admittance and then at least two weeks later prior to release.

Required serological tests for release may be based on a documented incidence(s) of pathogen(s) or disease in a given geographic area, on the potential for epizootics or on the potential for known or suspected agents to have a significant impact on wild animals or human health.

Microbial culture (aerobe, anaerobe, fungal). Microbial isolation provides a definitive answer to the presence of a microbe; however, failure to isolate the organism in culture does not mean the microbe is not present. When indicated by the condition of the animal, microbial cultures and sensitivities may be done to better guide therapeutic actions. In addition, external lesions which do not heal as expected should be cultured.

Polymerase Chain Reaction. Polymerase Chain Reaction (PCR) or reverse transcriptase-PCR is used routinely in medicine to identify pathogens in a variety of samples. Polymerase Chain Reaction can be performed on blood, tissues (frozen, fixed or embedded), fluids or smears. There are a number of marine mammal pathogens for which we have DNA probes, such as: morbillivirus, influenza virus, and brucella (see Appendix H for a list of recommended diagnostic microbiology laboratories). This technique may be used, if indicated, to diagnose acute, subclinical or latent infection. Pending the results of ongoing research, it may be recommended as the method of choice for determining whether pathogens are present or are being shed.

Infectious disease considerations to be made in cases of known or new infectious diseases with epizootic potentials. This would also be applicable in die-off situations. These criteria will be used on a disease-by-disease basis.

* Standardized sample collection and testing have been established, and through an agreement with the National Veterinary Services Lab, a performance based Analytical Quality Assurance program [AQA] has also been established. Testing should only be performed in labs which are participating in the AQA (Appendix H).

* Non-exposed animals may be released if they have two negative titers at least two weeks apart, have no history of recent exposure, and are clinically healthy and off medication for at least a week.

* Release of exposed animals (positive titer) in non-endemic areas will be determined on a case-by-case basis.

* Exposed animals in endemic areas
    1) Serial titers to be determined.
    2) Animals with stable or declining titers and no clinical illness ay be released.
    3) Animals with rising titer or which are clinically ill cannot be released until the animal shows full recovery, is off medicine for a minimum of seven days, and exhibits a stable or declining titer (after two consecutive titers at two week intervals). Again, this will be on a case-by-case, region-by-region, or disease-by-disease basis.

E. Cytology. Cytology may include sampling from pharynx, nasal, stomach, skin, vagina/prepuce, and anus/fecal. In addition, any gross external lesions which do not heal normally should be examined. Cytological examinations may be used to identify infectious diseases, inflammatory conditions, or tumors.

Summary: The animal must be determined clinically healthy by the staff veterinarian. Prior to certification for release, the animal should be free of drugs used for treatment (the use of sedatives or immobilizing drugs to aid in transport and release may be necessary) for a minimum of one week without presenting any clinical signs of illness. This is to prevent drugs masking signs of disease and to minimize the development of drug resistant microbes. This time span should be scaled (expanded) relative to the nature of the disease organism and the length of time an animal has been given antibiotics.

6.4 Behavioral Considerations

6.4.1 General Behavior

Only the most basic behavioral evaluations are possible in rehabilitation situations. It would be unrealistic to expect the demonstration of anything but a few basic behavior patterns prior to release. The limitation imposed by the captive environment and the lack of knowledge of what constitutes "normal behavior" for many species of marine mammals prohibits extensive behavioral testing.

Before release may be considered, an experienced animal care provider must evaluate whether a manatee is able to respire, swim , locomote, maneuver, and dive normally. The animal should not demonstrate any obvious aberrant behavior indicating a medical condition or other condition that might be detrimental to its survival in the wild. If the animal's behavior is determined to be normal, then its release candidacy evaluation should continue (providing all other natural history, medical, ethical and logistical criteria are met).

Physical deficits must be evaluated on a case-by-case basis. For example, manatees with watercraft-related injuries may be missing an entire fluke or portions thereof. Despite these injuries, some animals are capable of thriving in the wild. The severity of these injures and the effect they may have on the animal's viability in the wild must be assessed when considering the releasability of these individuals.

6.4.2 Foraging ability

Wild-reared manatees with experience foraging in the wild are the best release candidates. In the wild, manatees feed on a wide range of food types including submergent, emergent and floating vegetation. Animals raised in captivity from infancy have no experience with wild foods and associated feeding behaviors. They are typically fed food items not normally found in the wild and under artificial conditions. These animals should be introduced to wild foods and feeding behaviors characteristic of wild manatees in preparation for release. Animals that demonstrate adequate foraging skills should be good release candidates.

6.5 Release

6.5.1 Animal Preparation

Deconditioning behaviors. If animals can be released in a timely manner, conditioned behaviors should not be a concern. The FWS believes that the longer a manatee is maintained in a captive environment, the less likely it is that reintroduction will be successful. The longer an animal is in captivity, the more it may feel comfortable with people, and therefore, may require more deconditioning.

In order to prevent the acquisition of unnatural behaviors, interaction with humans should be kept to a minimum and limited to activities such as force-feeding, treatments, etc. No attempt should be made to train release candidates and hand-feeding should be avoided. Minimizing contact may be difficult or even impossible in some cases, however, due to the intensive physical care necessary for rehabilitation. In some cases, extensive contact with humans may benefit resolution of a medical case by providing needed mental stimulation and behavioral enrichment.

If an animal has become accustomed to hand-feeding or boat-following, the animal may approach humans after release. Therefore, these behaviors should be deconditioned before the animals can be considered for release. Most behaviors will extinguish through lack of reinforcement, but some may require more concentrated efforts. The success of deconditioning can be assessed through

observations of the fading of undesirable behaviors.

Marking/tagging. All release candidates should be marked in such a way as to be easily identifiable. Although the least intrusive method for identifying animals is to sketch and photograph markings such as scar, fluke patterns, etc., these may not be sufficient to allow field identification or monitoring of the animal. More intrusive techniques include freeze-branding, PIT tagging, or satellite or VHF tags. Radio tracking should compliment management and research objectives when appropriate.

6.5.2 Release Site Selection

Animals should be released in the general geographic area of capture. In general, Florida manatees rescued on Florida's east coast should be released on the east coast and west coast animals should be released on the west coast. For captive-born animals, the release site will depend on the parental history and site suitability. If possible, animals should be released during the spring or early summer. Late fall and winter releases should be avoided.

6.5.3 Monitoring

Rehabilitated manatees should be monitored following their release. Released animals may be tracked using both passive and active monitoring techniques. In Florida, rescue and salvage networks encounter released animals either as carcasses or rescue cases. When animals are located under these circumstances, they are identified by scar patterns, freeze brands, and PIT-tags. These passive techniques provide follow-up monitoring and do not allow for real time monitoring of animals subsequent to their release. Manatees are also tagged with satellite and VHF tags to allow for real time monitoring; animals with these devices can be closely monitored at appropriate intervals. Information gathered through monitoring efforts will be processed and used to guide future releases.

6.6 Manatee Release Categories

The FWS has incorporated release considerations into prioritized release categories (see Table 9). These categories use primary criteria, i.e., medical histories, length of time in captivity, origin and size to rank the categories. Secondary criteria are also taken into account when using the categories to evaluate release candidates.

Table 8. Manatee Release Categories.

The Fish and Wildlife Service distinguishes four categories of release candidates as described below

1. Categories. (Category 1 animals are the best release candidates and Category 4 animals are non-releasable).

Category 1 - Ready for release:

a. Generally short-term captive (<1 year)
b. No medical problems
c. Does not include captive-born or orphaned animals
d. >200 cm in length

Category 2 - Handled on a case-by-case basis, may require staging:

a. No medical problems
b. 1-5 or 5-10 years in captivity
c. May include captive-born animals, foster- or hand-reared
d. >200 cm, favoring larger animals as best candidates

Category 3 - Generally will require staging, decided on a case-by-case basis:

a. Includes hand-reared orphans, inbred captive-born, and long-term captives (10-15 years)
b. May include animals judged as non-releasable, depending on the outcome of releasing higher ranked animals within this category
c. >200 cm

Category 4 - Non-releasable, based on one or more of the following:

a. Medical history precludes release
b. < 200 cm in length, unless accompanied by the mother
c. 15 years or more in captivity

2. Primary Criteria

a) Medical history. "Yes": suitable for release or "No": unsuitable for release at the present time due to medical condition, reproductive status, inbreeding or potential disease risk.

b) Length of time in captivity. Five classes are considered: (1) < 1 year; (2) 1 to < 5 years; (3) 5 to < 10 years; (4) 10 to 15 years; (5) > 15 years. Manatees held for shorter periods rank higher than those held longer.

c) Origin. (1) wild born; (2) orphaned at an early age; (3) orphaned as a larger calf [orphans are further categorized as foster reared and hand reared]; and (4) captive-born [further categorized as reared by dam, foster reared or hand reared].

d) Size. Three categories are considered: (1) < 200 cm; (2) 200 to 275 cm; and (3) > 275 cm. Manatees < 200 cm will not be released. Manatees in the larger size classes rank higher than those in the intermediate category. Size is important because larger animals fare better in cooler weather, can handle a wider range of food types, etc.

3. Secondary criteria.

a) Place of origin. East coast or west coast. As a general rule for captive-born animals, consideration will be given to release site(s) based on the parent's original capture or release sites.

b) Sex. Rankings by sex depend on the current distribution of animals in facilities that maintain segregation to minimize uncontrolled breeding.

c) Other. Captive research programs require that certain individuals be retained for the duration of research studies. This may result in a delay in reassigning an individual manatee to higher priority status for release consideration.

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APPENDIX A. Select Sections of the MMPA

Section 109(h)

(1) Nothing in this title or title IV shall prevent a Federal, State, or local government official or employee or a person designated under section 112 (c) from taking, in the course of his or her duties as an official, employee, or designee, a marine mammal in a humane manner (including euthanasia) if such taking is for--

(A) the protection or welfare of the mammal,
(B) the protection of the public health and welfare, or
(C) the nonlethal removal of nuisance animals.

(2) Nothing in this title shall prevent the Secretary or a person designated under 112(c) from importing a marine mammal into the United States if such importation is necessary to render medical treatment that is not otherwise available.

(3) In any case in which it is feasible to return to its natural habitat a marine mammal taken or imported under circumstances described in this subsection, steps to achieve that result shall be taken.

50 CFR Chapter II Part 216.27

Release, non-releasability, and disposition under special exception permits for rehabilitated marine mammals.

(a) *Release requirements.*

(1) Any marine mammal held for rehabilitation must be released within six months of capture or import unless the attending veterinarian determines that:

(i) The marine mammal might adversely affect marine mammals in the wild;

(ii) Release of the marine mammal to the wild will not likely be successful given the physical condition and behavior of the marine mammal; or

(iii) More time is needed to determine whether the release of the marine mammal to the wild will likely be successful. Releasability must be reevaluated at intervals of no less than six months until 24 months from capture or import, at which time there will be a rebuttable presumption that release into the wild is not feasible.

(2) the custodian of the rehabilitated marine mammal shall provide written notification prior to any release into the wild.

(i) Notification shall be provided to:

(A) The NMFS Regional director at least 15 days in advance of releasing any beached or stranded marine mammal. Unless advance notice is waived in writing by the Regional Director; or

(B) The Office Director at least 30 days in advance of releasing any imported marine mammal.

(ii) Notification shall include the following:

(A) A description of the marine mammal, including its physical condition and estimated age;

(B) The date and location of release; and

(C)The method and duration of transport prior to release.

(3) The Regional Director, or the Office Director as appropriate, may:

(i) Require additional information prior to any release;

(ii) Change the date or location of release or the method or duration of transport prior to release;

(iii) Impose additional conditions to improve the likelihood of success or to monitor the success of the release; or

(iv) require other disposition of the marine mammal.

(4) All marine mammals must be released near wild population of the same species, and stock if known, unless a waiver is granted by the Regional Director or the Office Director.

(5) All marine mammals released must be tagged or marked in a manner acceptable to the Regional Director or the Office Director. The tag number or description of the marking must be reported to the Regional Director or Office Director following release.

(b) *Non-releasability and postponed determinations.*

(1) The attending veterinarian shall provide the Regional Director or Office Director with a written report setting forth the basis of any determination under paragraphs (a)(1)(i) through (iii) of this section.

(2) Upon receipt of a report under paragraph (b)(1) of this section, the Regional Director or Office Director, in their sole discretion, may:

(i) Order the release of the marine mammal;

(ii) Order continued rehabilitation for an additional 6 months; or

(iii) Order other disposition as authorized.

(3) No later than 30 days after a marine mammal is determined unreleasable in accordance with paragraphs (a)(1)(i) through (iii) of this section, the person with authorized custody must:

(i) Request authorization to retain or transfer custody of the marine mammal in accordance with paragraph (c)of this section, or;

(ii) Humanely euthanize the marine mammal or arrange any other disposition of the marine mammal authorized by the Regional Director or Office Director.

(4) Notwithstanding any of the provisions of this section, the Office Director may require use of a rehabilitated marine mammal for any activity authorized under subpart D in lieu of animals taken from the wild.

(5) Any rehabilitate beached or stranded marine mammal placed on public display following a non-releasability determination under paragraph (a)(1) of the section and pending disposition under paragraph (c) of this section, or any marine mammal imported for medical treatment otherwise unavailable and placed on public display pending disposition after such medical treatment is concluded, must be held in captive maintenance consistent with all requirements for public display.

(c) *Disposition for a special exception purpose.*

(1) Upon receipt of an authorization request made under paragraph (b)(3)(i) of this section, or release notification under (a)(2), the Office Director may authorize the retention or transfer of custody of the marine mammal for a special exception purpose authorized under subpart D.

(2) The Office Director will first consider requests from a person authorized to hold the marine mammal for rehabilitation. The Office Director may authorize such person to retain or transfer custody of the marine mammal for scientific research, enhancement, or public display purposes.

(3) The Office Director may authorize retention or transfer of custody of the marine mammal only if:

(i) Documentation has been submitted to the Office Director that the person retaining the subject animal or the person receiving custody of the subject animal by transfer hereinafter referred to as the recipient, complies with public display requirements of 16 U.S.C. 1374(c)(2)(A) or, for purposes of scientific research and enhancement, holds an applicable permit, or an application for such a special exception permit under Section 216.33 or a request for a major amendment under Section 216.39 has been submitted to the Office Director and has been found complete;

(ii) The recipient agrees to hold the marine mammal in conformance with all applicable requirements and standards; and

(iii) The recipient acknowledges that the marine mammal is subject to seizure by the Office Director:

(A) If, at any time pending issuance of the major amendment of permit, the Office Director determines that seizure is necessary in the interest of the health or welfare of the marine mammal;

(B) If the major amendment or permit is denied; or

(C) If the recipient is issued a notice of violation and assessment, or is subject to permit sanctions, in accordance with 15 CFR part 904.

(4) There shall be no remuneration associated with any transfer, provided that, the transferee may reimburse the transferor for any and all costs associated with the rehabilitation and transport of the marine mammal.

(5) Marine mammals undergoing rehabilitation or pending disposition under this section shall not be subject to public display, unless such activities are specifically authorized by the Regional Director or the Office Director, and conducted consistent with the requirements applicable to public display. Such marine mammals shall not be trained for performance or be included in any aspect of a program involving interaction with the public; and

(6) Marine mammals undergoing rehabilitation shall not be subject to intrusive research, unless such activities are specifically authorized by the Office Director in consultation with the Marine Mammal Commission and its Committee of Scientific Advisors on Marine Mammals, and are conducted pursuant to a scientific research permit.

(d) *Reporting.* In addition to the report required under Section 216.22(b), the person authorized to hold marine mammals for rehabilitation must submit reports to the Regional Director or Office Director regarding release or other disposition. These reports must be provided in the form and frequency specified by the Regional Director or Office Director.

APPENDIX B. REFERENCES FOR ADDITIONAL INFORMATION

Dierauf, L. A. (Editor). 1990. CRC Handbook of marine mammal medicine: health, disease, and Rehabilitation. CRC Press, Boca Raton, FL, 735 pp.

Geraci, J. R. and V. J. Lounsbury. 1993. Marine mammals ashore, a field guide for strandings. Texas A&M University Sea Grant College Program, Galveston, TX, 305 pp.

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APPENDIX C. NATIONAL AND REGIONAL STRANDING COORDINATORS

NMFS National Stranding Coordinator
Office of Protected Resources
1315 East West Highway
Silver Spring, MD 20910
(301)713-2322.
Pager: 1-800-494-2989

NMFS Northeast Regional Stranding Coordinator
166 Water Street
Woods Hole, MA 02543
(508) 495-2090
Pager: (978) 585-7149

NMFS Southeast Regional Stranding Coordinator
9721 Executive Center Drive, N.
St. Petersburg, FL 33702-2432
(813)570-5312
and
NMFS Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149
(305)361-4586 or (305)361-5761
24 hour pager (305)862-2850

NMFS Alaska Regional Stranding Coordinator
P.O. Box 21668
Juneau, AK 99802-1668
(907)586-7235

NMFS Northwest Regional Stranding Coordinator
7600 Sand Point Way, N.E.
Bin C15700, Bldg. 1
Seattle, WA 98115-0070
(206)526-6733

NMFS Southwest Regional Stranding Coordinator
501 West Ocean Blvd.
Long Beach, CA 90802
(562)980-4017
and
NMFS Hawaii Stranding Coordinator
2670 Dole Street
Honolulu, HI 96822
(808)973-2987

Manatee Recovery Coordinator
U.S. Fish and Wildlife Service Enhancement Office
6620 Southpoint Drive, South, Suite 310
Jacksonville, Florida 32216
(904)232-2580
A toll-free number has been set up in Florida to report manatee strandings: 1-800-342-5367.

Sea Otters in California
Sea Otter Hotline Number (408)648-4829
U.S. Fish and Wildlife Office in Ventura, CA
(805)644-1766

Polar Bears, Sea Otters, and Walrus in Alaska
Marine Mammals Management
U.S. Fish and Wildlife Service
1011 East Tudor Road
Anchorage, AK 99503-6199
(907)786-3800

Office of Management Authority
U.S. Fish and Wildlife Service
4401 North Fairfax Drive, Room 700
Arlington, Virginia 22203
(703) 358-2104

APPENDIX D. PHYSICAL EXAMINATION/CLINICAL EVALUATION

External examination should include documentation of the parameters listed below. The suggested format is offered for consistency of record keeping/comparison of data.

Date_____ Tag/Freeze brand number_____ Entry/Rehab/Exit Exam_____
Age_____ Sex_____ Length_____ Weight_____ Ax girth_____

Clinical diagnosis/clinical treatment
Status at stranding
 medical
 age
Population of origin (if known)
 geographic range
 infectious disease/health
Exposure to disease during rehabilitation
Treatments during rehabilitation
Developmental history
 physical
 behavioral
Other

I verify that animal (tag/freeze brand #)_____ species_____
is fully recovered, is off medication for one week and is a suitable candidate for release.
Print_____
Signed_____ Date_____
Title_____

Behavioral Evaluation
Behavioral evaluation should include documentation of all behaviors. The suggested format is offered for consistency of record keeping and comparison of data.
I verify that animal (tag/freeze brand #)_____ species_____
is recovered and a suitable candidate for release.
Print_____
Signed_____ Date_____
Title_____

APPENDIX E. CHECKLIST FOR ON-SITE MEDICAL AND BEHAVIORAL EVALUATION
(this information does not need to be submitted to NMFS)

Medical

Exam	Normal / Abnormal	Describe
Body Condition		
conformation		
blubber depth		
muscle mass		
Integument		
coloration		
scars		
lesions		
Ocular		
eye color		
discharge		
response to light		
Oral		
teeth		
color		
wear		
mucosa		
color		
integrity		
Musculoskeletal		
Cardio-respiratory		
auscultation		
respiration		
depth/excursion		
rate		
character		
buoyancy/listing		
blowhole		
odor		
discharge		

Gastro intestinal
feces
color
consistency
frequency
Urinary analysis
External Genitalia
shape/character
size
discharge
Other

Behavioral

Behavior	Observed/Not Observed	Describe
General		
abnormal posturing		
regurgitation		
other		
stereotypic		
Social compatibility		
aggressive		
submissive		
external wounds		
Appetite		
change in food preference		
periods of anorexia		
inconsistent appetite		
other		
Exposure to humans		
dependent on staff		
trained		

APPENDIX F. BLOOD CHEMISTRY ABBREVIATIONS

ALT: alanine aminotransferase
AP or ALKPHOS: alkaline phosphatase
AST: aspartate aminotransferase
BANDS: immature segmented neutrophils
Basos: basophilic leukocyte
BUN: blood urea nitrogen
Ca^{++}: calcium ion
CBC: complete blood count
CK or CPK: creatine phosphokinase
Cl^{-}: chloride ion
Eos: eosinophilic leukocyte
GGT: gamma glutamyl transferase
Hb or HGb: hemoglobin
LDH: lactate dehydrogenase
Lymphs: lymphocytes
MCH: mean corpuscular hemoglobin
MCHC: mean corpuscular hemoglobin concentration
MCV: mean corpuscular volume
Mono: monocyte
PCV: packed cell volume or HCT: hematocrit
PLT: platelet
PMN: polymorphonuclear neutrophil leukocyte
K^{+}: potassium ion
RBC: red blood cell
Na^{+}: sodium ion
SEGS: segmented neutrophils
WBC: white blood cell; white blood cell count

APPENDIX G. LIST OF IMMUNOLOGICAL COMPETENCY TESTS

- Leukocyte subset characterization
  Identification of leukocyte population imbalances by flow cytometry. Application of immunohistochemistry of biopsy/necropsy samples.

- Lymphocyte function
  Measures responsiveness of lymphocytes to specific and non-specific stimuli

- Measurement of immunoglobulin
  Assay of total immunoglobulin and antigen-specific immunoglobulin by ELISA using species-specific reagents

- Inflammatory mediators
  Measurements of systemic acute phase proteins (C-RP) and inflammatory mediators (IL-6, IL-1) by ELISA and bioassay

APPENDIX H. RECOMMENDED DIAGNOSTIC LABORATORIES

Armed Forces Institute of Pathology
Department of Veterinary Pathology
Walter Reed Army Med. Center
Washington, DC 20306-6000
(202)576-2453/2454
(*virology, immunohistochemistry, PCR, histopathology*)
Contact: Dr. Thomas Lipscomb

USDA National Veterinary Services Laboratory
P.O. Box 844
Ames, Iowa 50010
(515)239-8551
(*serology, culture, PCR, bacteriology*)
Contact: Dr. Beverly Schmitt

American Type Culture Collection
12301 Parklawn Drive
Rockville, MD 20852
(301)881-2600
(*culture*)
Contact: Dr. Charles Buck

University of Miami
School of Medicine
Comparative Pathology Laboratory
1550 Northwest 10th Ave
Miami, FL 33136
(305)-243-6012
(*culture, serology, immunohistochemistry, histopathology, PCR, and in situ hybridization*)
Contact: Dr. Greg Bossart

USDA Foreign Animal Disease
Diagnostic Laboratory
Orient Point Warehouse
Route 58
Orient Point, NY 11957
(516)323-2500
(*serology and culture*)
Contact: Dr. Carol House

National Wildlife Health Center
6006 Schroeder Dr.
Madison, WI 53711
(*culture*)
Contact: Dr. Mark Wolcott

Veterinary Sciences Division
Department of Agriculture
Stormont, Belfast BT4 3SD
Northern Ireland
011-44-1232-525701
(*morbillivirus - serology and culture*)
Contact: Dr. Seamus Kennedy

Oklahoma State Diagnostic Laboratory
P.O. Box 7001
Stillwater, OK 74076-7001
(405)744-6623
(*morbillivirus serology, culture*)
Contact: Dr. Jerry Saliki

Oregon State University
College of Veterinary Medicine
105 Magruder Hall
Corvallis, OR 97331-4802
(*serology and viral isolation*)
(541)737-2318 or (541)737-6550
Contact: Dr. Al Smith

University of California
School of Veterinary Medicine
Department of Pathology, Microbiology and Immunology
1 Shields Avenue
Davis, CA 95616
(Immune cell phenotyping, leukocyte function, immunoglobulin measurement, Inflammatory mediators, viral serology , (morbilli/PHV-1), viral PCR
lymphocyte cryopreservation)
(530) 752-2543 or (530) 752-7187
Contact: Dr. Jeff Stott